September 1997
Volume 42, Number 9
ISSN 0020-1324-RECACP

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Respiratory Care (ISSN 0020-1324, USPS 0489-190) is published monthly by Daedalus Enterprises Inc, at 11030 Ables Lane, Dallas TX 75229-4593, for the American Association for Respiratory Care. One volume is published per year beginning each January. Subscription rates are $65 per year in the US; $80 in all other countries (for airmail, add $84).

The contents of the Journal are indexed in Hospital and Health Administration Index, Cumulative Index to Nursing and Allied Health Literature, Excerpta Medica, and RNdex Library Edition. Abridged versions of Respiratory Care are also published in Italian and Japanese, with permission from Daedalus Enterprises Inc.

Periodicals postage paid at Dallas TX and at additional mailing offices. POSTMASTER: Send address changes to Respiratory Care, Membership Office, Daedalus Enterprises Inc, 11030 Ables Lane, Dallas TX 75229-4593.

Printed in the United States of America

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Editorials, Commentaries, and Reviews To Note

Effects of Growth and Development on Lung Function: Models for Study of Childhood Asthma (NHLBI Workshop Summary)—WW Busse, SP Banks-Schlegel, GL Larsen. Am J Respir Crit Care Med 1997;156: 314-319

Inhaled Bronchodilator Therapy in Mechanically Ventilated Patients (Pulmonary Perspective)—R Dhand, MJ Tobin. Am J Respir Crit Care Med 1997;156:3-10.

Cytomegalovirus: The Monster in the Closet? (Editorial)—RP Baughman. Am J Respir Crit Care Med 1997;156:1-2.

Pulmonary Artery Catheter Consensus Conference: Consensus Statement—Pulmonary Artery Catheter Consensus Conference Participants. Crit Care Med 1997;25(6):910-925. *See the related editorials: **Pulmonary Artery Catheter Consensus Conference**—EC Rackow. Crit Care Med 1997;25(6):901 and **The Flow-Directed, Pulmonary Artery Catheter and Outcome in Critically Ill Patients: Have We Heard the Last Word?** MP Fink. Crit Care Med 1997;25(6):902-903.*

Safety of One Method of Sputum Induction in Asthmatic Subjects—HH Wong, JV Fahy. Am J Respir Crit Care Med 1997;156:299.

To assess the safety of sputum induction in asthmatic subjects, we conducted a retrospective review of data from 351 sputum inductions in 78 subjects from our institution. The sputum induction protocol consisted of baseline FEV_1, pretreatment with albuterol 180 μg, postbronchodilator spirometry 15 minutes later, the induction procedure itself (inhalation of 3% saline for 20 min), and postsputum induction spirometry. We found that sputum induction was usually well tolerated, although some subjects developed wheeze and dyspnea. Overall, 11 of the 78 subjects (14%) had a fall in FEV_1 of $\geq 20\%$ from the postbronchodilator baseline ("excessive bronchoconstriction") during their first sputum induction (range: −20 to −69%); no subject developed refractory bronchoconstriction requiring hospitalization or emergency room treatment. Only 1 of the 54 subjects (1.9%) with a baseline prebronchodilator $FEV_1 > 80\%$ had excessive bronchoconstriction, whereas 10 of the 24 subjects (42%) whose baseline FEV_1 was $\leq 80\%$ predicted did so. The change in FEV_1 during sputum induction was significantly correlated with the baseline prebronchodilator FEV_1 percent predicted, the baseline postbronchodilator FEV_1 percent predicted, the PC_{20} for methacholine, and the percentage of eosinophils in induced sputum. We conclude that 180 μg albuterol does not prevent excessive bronchoconstriction in all asthmatic subjects undergoing sputum induction, especially in asthmatic subjects with a low baseline FEV_1. Pulmonary function should be monitored regularly during sputum induction in asthmatic subjects to monitor for excessive bronchoconstriction.

Effect of Failed Extubation on the Outcome of Mechanical Ventilation—SK Epstein, RL Ciubotaru, JB Wong. Chest 1997;112(1):186.

OBJECTIVE: To examine medical outcomes associated with reintubation for extubation failure after discontinuation of mechanical ventilation. DESIGN: Prospective cohort study of consecutive intubated medical ICU patients who underwent a trial of extubation at a tertiary-care teaching hospital. The failed extubation group consisted of all patients reintubated within 72 hours or within 7 days (if continuous ICU care had been required) of extubation. All others were considered to be successfully extubated. Study end points included hospital death versus survival, the number of days spent in the ICU and in the hospital after the onset of mechanical ventilation, the likelihood of requiring ≥ 7 or ≥ 14 days of ICU care after extubation, and the need for transfer to either a long-term care or rehabilitation facility among the survivors. RESULTS: Of 289 intubated patients, 247 (85%) were successfully extubated, and 42 (15%) required reintubation for failed extubation (time to reintubation 1.5 ± 0.2 days). Reintubation for extubation failure resulted in 12 additional days of mechanical ventilation. When compared with successfully extubated patients, reintubated patients were more likely to die in the hospital (43% vs 12%; $p < 0.0001$), spend more time in the ICU (21.2 ± 2.8 days vs 4.5 ± 0.6 days; $p < 0.001$) and in the hospital (30.5 ± 3.3 days vs 16.3 ± 1.2 days; $p < 0.001$) after extubation, and require transfer to a long-term care or rehabilitation facility (38% vs 21%; $p < 0.05$). Using multiple logistic regression, extubation failure was an independent predictor for death and the need for transfer to a long-term care facility. Compared with those successfully extubated, patients who failed extubation were 7 times ($p < 0.0001$) more likely to die, 31 times ($p < 0.0001$) more likely to spend ≥ 14 days in the ICU after extubation, and 6 times ($p < 0.001$) more likely to need transfer to a long-term care or rehabilitation facility if they survived. CONCLUSION: After adjusting for severity of illness and comorbid conditions, extubation failure had a significant independent association with increased risk for death, prolonged ICU stay, and transfer to a long-term care or rehabilitation facility. Extubation failure may serve as an additional independent marker of severity of illness. Alternatively, poor outcomes may be etiologically related to extubation failure. If the latter proves to be the case, identifying patients at risk for poor outcomes from extubation failure and instituting alternative care practices may reduce mortality, duration of ICU stay, and need for transfer to a long-term care facility.

The Value of Routine Microbial Investigation in Ventilator-Associated Pneumonia—J Rello, M Gallego, D Mariscal, R Soñora, J Valles. Am J Respir Crit Care Med 1997;156:196.

The use of microbiologic investigations in routine clinical practice, their value in guiding antibiotic prescription, and their influence on outcome were prospectively studied in 113 consecutive adults who developed ventilator-associated pneumonia (VAP). Blood cultures were performed in 78.7% of cases, protected specimen brushing in

95.5%, and bronchoalveolar lavage in only 45.1%. No causative agent was identified in 13 episodes (11.5%), and results of microbial tests directed a change in therapy in 43 (38.0%). Bronchoscopic results revealed inadequate initial selection of antibiotic therapy in 27 cases (23.9%) and led to a change in antibiotic treatment. Inadequate initial selection was still associated with a significantly greater increase in related mortality than adequate initial therapy (37.0% vs 15.4%, $p < 0.05$), although the change in therapy permitted clinical resolution in 17 (62.9%) of these 27 episodes, and 10 patients were discharged alive. Bronchoscopic results also permitted the reduction of the antibiotic spectrum in 7 episodes (6.1%). This study suggests that in patients with VAP, bronchoscopic results are frequently associated with changes in antibiotic therapy. Nevertheless, our findings also emphasize the critical importance of an appropriate early antibiotic therapy.

Risk of Tuberculin Conversion According to Occupation among Health Care Workers at a New York City Hospital—J Louther, P Rivera, J Feldman, N Villa, J DeHovitz, KA Sepkowitz. Am J Respir Crit Care Med 1997;156:201.

Concern about the risk to health care workers of occupationally acquired tuberculosis has resulted in extensive and frequently revised guidelines from the Centers for Disease Control and Prevention (CDC). Most recent studies, however, have determined that community, rather than occupational, exposure is the more significant risk for tuberculin conversion. To assess the relative contribution of community versus occupational risk, we reviewed the health records of 1,303 persons employed from 1991 to 1994 at St Clare's Hospital in New York City, a hospital with a high tuberculosis case-rate. Demographic information included age, gender, postal zone of residence, country of birth, and BCG vaccination status, while occupations were placed into 1 of 5 groups. In multivariate analysis, occupation was significantly associated with risk of tuberculin conversion, while postal zone of residence was not. The group that included housekeeping, laundry, and security personnel and the physician-nurse group had the highest conversion rates. After implementation of CDC guidelines, there was a significant improvement in the employee tuberculin conversion rate. At our hospital, occupation was strongly associated with risk of tuberculin conversion.

No Evidence for Effects of Family Environment on Asthma: A Retrospective Study of Norwegian Twins—JR Harris, P Magnus, SO Samuelsen, K Tambs. Am J Respir Crit Care Med 1997;156:43.

The risk of developing asthma contingent upon the co-twins' history of asthma was analyzed in a population-based study of 5,864 Norwegian twins. A primary aim was to assess the significance of shared environment for the development of asthma from infancy through age 25. Retrospective reports were collected when the twins were 18 to 25 years of age. The risk of developing asthma, contingent upon the co-twin's history of asthma, was estimated using survival analyses, and genetic and environmental sources of variation in liability for asthma were analyzed with structural equation models. The cumulative incidence of asthma was 6% for males and 5.4% for females. The relative risk of developing asthma among twins whose co-twin had a positive history of asthma compared with those whose co-twin had no history of asthma was 17.9 (95% CI, 10.3 to 31.0) for identical, and 2.3 (95% CI, 1.2 to 4.4) for fraternal twins. Although shared envi-

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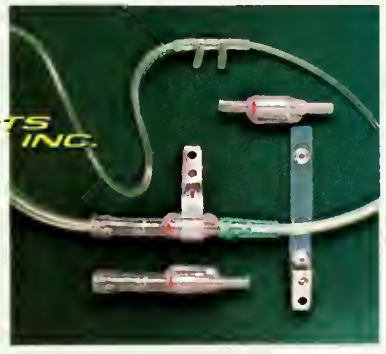

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ronment encompasses many of the exposures that are putative risk factors for asthma in this age range, there is no evidence of shared environmental influences for asthma. Rather, 75% of the variation in liability for asthma was explained by genetic effects and the remaining variation was due to nonshared environmental influences. These results suggest that the familial risk for asthma is primarily, genetic.

Ventilatory-Control Abnormalities in Familial Sleep Apnea—S Redline, J Leitner, J Arnold, PV Tishler, MD Altose. Am J Respir Crit Care Med 1997;156:155.

The role of ventilatory-control abnormalities in predisposing to familial sleep-disordered breathing (SDB) was assessed in 31 subjects 28 ± 10 years of age (mean ± SD). Subjects with (n = 10) and without SDB (n = 12) were recruited from 13 families having 2 or more members with SDB. Nine age- and gender-matched controls were recruited from families having no member with SDB. Respiratory responses to eucapnic hypoxia, and ventilatory and occlusion pressure responses to hyperoxic hypercapnia with and without added resistive loads (6.5 cm H_2O/L/s), were assessed through rebreathing. Age, FEV_1, and FVC did not differ among the groups. Hypoxic responses ($\Delta V_E/\Delta S_{aO_2}$) were significantly lower among the first-degree relatives of SDB families than among controls (−0.76 ± 0.47 L/min/% S_{aO_2}, and −1.32 ± 0.92 L/min/% S_{aO_2}, respectively, $p < 0.05$). Respiratory responses to hypercapnia during unloaded conditions were similar among the groups. With resistive loading, inspiratory impedance, as measured through the relationship of mouth occlusion pressure (P_{100}) to inspiratory flow (V_T/T_I), increased with increasing hypercapnia to a greater extent in members of SDB families than in controls (0.169 ± 0.054 cm H_2O/L/min vs 0.122 ± 0.051, respectively, $p < 0.05$). These data suggest that familial SDB may be based partly on a familial abnormality in ventilatory control associated with blunting of the hypoxic ventilatory response. The greater increase in impedance during inspiratory loading in members of affected families also suggests a propensity for dynamic airway narrowing.

A Rapid Qualitative Assay To Detect Circulating Endotoxin Can Predict the Development of Multiorgan Dysfunction—MH Kollef, PR Eisenberg. Chest 1997;112(1):173.

OBJECTIVE: To determine whether a rapid qualitative assay for the detection of circulating endotoxin (SimpliRED Endotoxin Test [SRE]; AGEN, Inc; Brisbane, Australia) can predict the occurrence of multiorgan dysfunction and hospital mortality. To compare the SRE to the limulus amebocyte lysate (LAL) assay as a predictor of clinical outcomes. DESIGN: Prospective, blinded, single-center study. SETTING: Medical ICU of Barnes-Jewish Hospital, St Louis, a university-affiliated teaching hospital. PATIENTS: Included in the study were 265 adult patients requiring medical ICU admission. INTERVENTIONS: Daily collection of blood samples. MEASUREMENTS & RESULTS: Daily detection for the presence of endotoxin in blood during intensive care and assessment for the development of multiorgan dysfunction (ie, an organ system failure index > 2) or death. On ICU day 1, 55 (20.8%) patients had circulating endotoxin detected by the SRE. On ICU day 2, 29 of the 143 (20.3%) patients remaining in the ICU had a positive SRE. The development of multiorgan dysfunction was significantly greater among SRE-positive patients (44.8%) compared to SRE-negative patients (21.9%) on ICU day 2 ($p = 0.013$). Multiple logistic regression analysis identified a positive SRE on ICU day 2 (adjusted odds ratio, 4.1; 95% confidence interval, 2.5 to 6.8; $p = 0.006$) as being independently associated with the development of multiorgan dysfunction. A positive SRE test was not predictive of hospital mortality. Direct quantitative measurement of the concentration of circulating endotoxin using the LAL assay was not associated with either the development of multiorgan dysfunction or hospital mortality ($p > 0.1$). CONCLUSIONS: Our preliminary data suggest that a bedside assay to qualitatively detect circulating endotoxin is predictive of the development of multiorgan dysfunction among patients admitted to a medical ICU. The rapid detection of circulating endotoxin could be useful for stratifying patients into various risk categories for the development of multiorgan dysfunction.

Treatment of Acute Severe Asthma with Inhaled Albuterol Delivered via Jet Nebulizer, Metered Dose Inhaler with Spacer, or Dry Powder—AC Raimondi, J Schottlender, D Lombardi, NA Molfino. Chest 1997;112(1):24

Despite the increasing use of dry powder formulations in the ambulatory setting, there is a paucity of information on the efficacy of this therapeutic modality to treat acute severe asthma. In addition, studies that compared wet nebulization versus metered dose inhalers formulated with chlorofluorocarbon (CFCMDI) attached to holding chambers have yielded discrepant results. Thus, it is unclear which of the 3 delivery systems would elicit a superior bronchodilator response, particularly in patients with life-threatening asthma. In a prospective, randomized open design, we studied the response to inhaled albuterol (salbutamol) in 27 adult asthmatics presenting to the emergency department (ED) with an $FEV_1 < 30\%$ predicted. Subjects were treated with one of the following regimens (9 subjects in each group): group A, mean (SD) baseline FEV_1 of 0.7 (0.2) L, received albuterol solution, 5 mg, via a nebulizer (Puritan-Bennett Raindrop; Lawrenceville GA) impelled with oxygen (O_2) at 8 L/min; group B, baseline FEV_1 of 0.6 (0.15) L, received albuterol, 400 μg, via a CFCMDI attached to a 145-mL valved aerosol holding chamber (Aerochamber; Trudell Medical; London ON); and group C, baseline FEV_1 of 0.6 (0.17) L, received albuterol powder, 400 μg, by another means (Rotahaler; Glaxo; Research Triangle Park NC). All groups received the respective treatments on arrival in the ED, every 30 minutes during the first 2 hours, and then hourly until the sixth hour. Clinical parameters and FEV_1 were recorded on ED admission and 15 minutes after each dose of albuterol. At the time of ED admission, all patients also received continuous O_2 and 1 dose of IV steroids (dexamethasone, 8 mg). The total dose of inhaled albuterol administered during the 6-hour treatment was 45 mg of nebulized solution in group A and 3,600 μg of albuterol aerosol and dry powder in groups B and C, respectively. No significant differences were found in the population demographics, baseline FEV_1, and arterial blood gas values on air. FEV_1 improved significantly in all patients after the 6 hours of treatment. The 6-hour area under the curve FEV_1 improved similarly with the 3 delivery methods despite differences in the total dose administered. No patient was discontinued during the trial or admitted to hospital and no evidence of cardiovascular adverse events was apparent in any of the study groups. These data support the view that the 3 delivery methods appear adequate to treat subjects with acute severe asthma.

A Cost-Effectiveness Analysis of Directly Observed Therapy vs Self-Administered Therapy for Treatment of Tuberculosis—WJ Burman, CB Dalton, DL Cohn, JRG Butler, RR Reves. Chest 1997;112(1):63.

OBJECTIVES: To compare the costs and effectiveness of directly observed therapy (DOT) versus self-administered therapy (SAT) for the treatment of active tuberculosis. DESIGN: Decision analysis. SETTING: We used published rates for failure of therapy, relapse, and acquired multidrug resistance during the initial treatment of drug-susceptible tuberculosis cases using DOT or SAT. We estimated costs of tuberculosis treatment at an urban tuberculosis control program, a municipal hospital, and a hospital specializing in treating drug-resistant tuberculosis. OUTCOME MEASURES: The average cost per patient to cure drug-susceptible tuberculosis, including the cost of treating failures of initial treatment. RESULTS: The direct costs of initial therapy with DOT and SAT were similar ($1,206 vs $1,221/patient, respectively), although DOT was more expensive when patient time costs were included. When the costs of relapse and failure were included in the model, DOT was less expensive than SAT, whether considering outpatient costs only ($1,405 vs $2,314/patient treated), outpatient plus inpatient costs ($2,785 vs $10,529/patient treated), or outpatient, inpatient, and patients' time costs ($3,999 vs $12,167/patient treated). Threshold analysis demonstrated that DOT was less expen-

sive than SAT through a wide range of cost estimates and clinical event rates. CONCLUSION: Despite its greater initial cost, DOT is a more cost-effective strategy than SAT because it achieves a higher cure rate after initial therapy, and thereby decreases treatment costs associated with failure of therapy and acquired drug resistance. This cost-effectiveness analysis supports the widespread implementation of DOT.

Methacholine Challenge Testing: Safety of Low Starting FEV_1—RJ Martin, JS Wanger, CG Irvin, BB Bartelson, RM Cherniack, and the Asthma Clinical Research Network. Chest 1997;112(1):53.

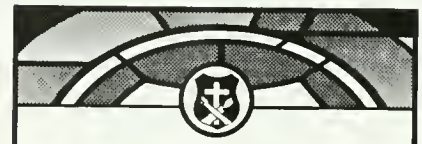
OBJECTIVE: The lower limit for the baseline value to initiate methacholine bronchial hyperresponsiveness testing has not been well established. Recommendations have varied from > 1 L to above 80% of predicted. The objective was to determine if an FEV_1 < 60% predicted was acceptable. DESIGN: Retrospective analysis of challenges in 88 patients with a baseline FEV_1 of < 60% predicted (mean = 45.8%; range, 22 to 59%. SETTING: Academic institutions. RESULTS: There were only 4 individuals whose FEV_1 did not return to > 90% of baseline following 1 post-study β_2-agonist treatment. All 4 responded to a second treatment. There were no adverse sequelae following challenge in any individual. Neither age (up to 79 years) nor gender influenced outcome. CONCLUSIONS: In chronic moderate to severe asthma, it appears that bronchial hyperresponsiveness testing can be safely performed even in those patients with a low baseline FEV_1.

Variation of Inhaled Nitric Oxide Concentration with the Use of a Continuous Flow Ventilator—APMC DeJaegere, FIM Jacobs, NGC Laheij, JN van den Anker. Crit Care Med 1997; 25(6):995.

OBJECTIVE: To investigate the homogeneity of nitric oxide concentrations at different ventilator settings in a delivery system using a continuous flow ventilator. DESIGN: A prospective bench study using a nitric oxide delivery system, mixing a nitrogen/nitric oxide gas mixture in the ventilator circuit with 2 types of continuous flow ventilators (Babylog 8000™, Draeger, Luebeck, Germany; Infant Star™, Infrasonics, San Diego CA). SETTING: A biomedical laboratory. INTERVENTIONS: A nitrogen/nitric oxide gas mixture was injected at 3 different sites in the ventilator circuit (just before and just behind the humidifier, and 20 cm before the Y-connector). Ventilator flow (12, 15, and 20 L/min) and rates (30 to 110 breaths/min with increments of 10 breaths/min) were changed as well as the compliance of the test lung (0.36, 0.5, and 1.0 mL/cm H_2O). Carbon dioxide, instead of nitrogen/nitric oxide, was injected at the same points in the circuit. MEASUREMENTS & MAIN RESULTS: The mean nitric oxide concentration increased significantly ($p < 0.001$) with increasing ventilator rates (although the flow ratio of the ventilator gas and the nitrogen/nitric oxide gas mixture was kept constant) when the nitrogen/nitric oxide injection site was near to the Y-connector of the ventilator circuit with both ventilators. The mean nitric oxide concentration did not change significantly when the nitrogen/nitric oxide gas mixture was mixed to the ventilator gas at the inlet of the humidifier, using the Babylog 8000 ventilator. Analysis of ventilator circuit flow patterns showed fluctuations during the respiratory cycle. The magnitude of the flow changes was different at the 3 injection sites in the ventilator circuit. Real-time measurements of the CO_2 concentration showed fluctuations during the distinct respiratory phases that differed at the separate injection sites. Mean CO_2 concentrations showed a similar pattern as compared with the mean nitric oxide concentration data at the same settings. CONCLUSIONS: Mixing a nitrogen/nitric oxide gas mixture 20 cm before the Y-connector results in an increase of the mean nitric oxide concentration with increasing ventilator rates. This phenomenon does not occur with the nitrogen/nitric oxide gas mixture mixed at the inlet of the humidifier, using a ventilator with a throughout constant flow at the inspiratory outlet of the ventilator. The fluctuations of the main ventilator circuit flow result in changing ratios of nitrogen/nitric oxide gas mixture and the ventilator gas flow. We speculate this changing flow ratio produces the increase in mean nitric oxide concentration within the ventilatory circuit. To ensure a constant concentration of nitric oxide by blending a nitrogen/nitric oxide gas mixture in the ventilator circuit of a continuous flow ventilator, the site of injection of the nitrogen/nitric oxide gas mixture should be at the point where ventilator circuit flow fluctuations are minimal.

High-Frequency Oscillatory Ventilation for Adult Respiratory Distress Syndrome—A Pilot Study—P Fort, C Farmer, J Westerman, J Johannigman, W Beninati, S Dolan, S Derdak. Crit Care Med 1997;25(6):937.

OBJECTIVE: To evaluate the safety and effectiveness of high-frequency oscillatory ventilation using a protocol designed to recruit and maintain optimal lung volume in patients with severe adult respiratory distress syndrome (ARDS). SETTING: Surgical and medical intensive care units in a tertiary care, military teaching hospital. DESIGN: A prospective, clinical study. PATIENTS: Seventeen patients, 17 years to 83 years of age, with severe ARDS (Lung Injury Score of 3.81 ± 0.23) failing inverse ratio mechanical conventional ventilation (P_{aO_2}/F_{IO_2} ratio of 68.6 ± 21.6, peak inspiratory pressure of 54.3 ± 12.7 cm H_2O, positive end-expiratory pressure of 18.2 ± 6.9 cm H_2O). INTERVENTIONS: High-frequency oscillatory ventilation was instituted after varying periods of conventional ventilation (5.12 ± 4.3 days). We employed a lung volume recruitment strategy that consisted of incremental increases in mean airway pressure to achieve a P_{aO_2} of ≥ 60 torr (≥ 8.0 kPa), with an F_{IO_2} of ≤ 0.6. MEASUREMENTS & MAIN RESULTS: High-frequency oscillator ventilator settings (F_{IO_2}, mean airway pressure, pressure amplitude of oscillation [ΔP] frequency) and hemodynamic parameters (cardiac output, oxygen delivery [$\dot{D}_{O_2}$]), mean systemic and pulmonary arterial pressures, and the oxygenation index (oxygenation index = [F_{IO_2} × mean airway pressure × 100]/P_{aO_2}) were monitored during the transition to high-frequency oscillatory ventilation and throughout the course of the high-frequency protocol. Thirteen patients demonstrated improved gas exchange and an overall improvement in P_{aO_2}/F_{IO_2} ratio ($p < 0.02$). Reductions in the oxygenation index ($p < 0.01$) and F_{IO_2} ($p < 0.02$) at 12, 24, and 48 hours after starting high-frequency oscillatory ventilation were observed. No significant compromise in cardiac output or $\dot{D}_{O_2}$ was observed, despite a significant increase in mean airway pressure (31.2 ± 10.3 to 34.0 ± 6.7 cm H_2O, $p < 0.05$) on high-frequency oscillatory ventilation. The overall survival rate at 30 days was 47%. A greater number of pretreatment days on conventional ventilation ($p < 0.009$) and an entry oxy-



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genation index of > 47 (sensitivity 100%, specificity 100%) were associated with mortality. CONCLUSIONS: High-frequency oscillatory ventilation is both safe and effective in adult patients with severe ARDS failing conventional ventilation. A lung volume recruitment strategy during high-frequency oscillatory ventilation produced improved gas exchange without a compromise in $\dot{D}_{O_2}$. These results are encouraging and support the need for a prospective, randomized trial of algorithm-controlled conventional ventilation versus high-frequency oscillatory ventilation for adults with severe ARDS. *See the related editorial:* ***High-Frequency Oscillatory Ventilation for Adult Respiratory Distress Syndrome: Let's Get It Right This Time!*** *AB Froese. Crit Care Med 1997;25(6): 906-908.*

Routine Portable Chest Radiographs in the Medical Intensive Care Unit: Effects and Costs—A Brainsky, RH Fletcher, HA Glick, PN Lanken, SV Williams, HL Kundel. Crit Care Med 1997;25(5):801.

OBJECTIVE: To determine the effects and net costs of routine chest radiographs in a medical intensive care unit (ICU). DESIGN: A prospective, cohort study. A survey of experts in critical care and pulmonary diseases was undertaken to assess the effect of routine radiographs on patient management. SETTING: Medical ICU of a university hospital. PATIENTS: Eighty randomly selected patients admitted to a medical ICU. Two hundred fourteen experts were surveyed; 118 (55%)/214 responded. MEASUREMENTS & MAIN RESULTS: Daily interviews with medical ICU clinicians were conducted to assess the radiographic findings in the routine radiographs and actions taken based on these findings. Experts evaluated the findings, their importance, the actions taken, and the probability of complications if the actions had not been taken at that time. Experts also predicted increases in length of stay associated with these complications. Presence of radiographic findings, changes in management because of the findings, net costs of routine chest radiographs, cost per finding that prompted an action, and expected changes in length of stay resulting from the actions were also assessed. Seventy-two (33%) of 221 routine radiographs (95% confidence interval: 26% to 39%) had findings, of which 44 (61%) were judged important, and 18 (8%, 95% confidence interval: 5% to 12%) prompted actions. Experts predicted that each action averted, on average, 2.1 ± 1.7 days (SD) in the medical ICU. Mean savings per routine radiograph was $98. Net savings from routine chest radiographs remained after sensitivity analysis for expected change in length of stay, percentage of patients with routine radiographs, and percentage of routine radiographs that produce changes in management. CONCLUSION: The policy of obtaining routine chest radiographs in the medical ICU is effective and results in net savings.

Additive Beneficial Effects of the Prone Position, Nitric Oxide, and Almitrine Bismesylate on Gas Exchange and Oxygen Transport in Acute Respiratory Distress Syndrome—P Jolliet, P Bulpa, M Ritz, B Ricou, J Lopez, J-C Chevrolet. Crit Care Med 1997;25(5):786.

OBJECTIVE: To test the hypothesis that prone position ventilation, nitric oxide, and almitrine bismesylate, each acting by a different mechanism to improve arterial oxygenation, could exert additive beneficial effects when used in combination in patients with severe acute respiratory distress syndrome (ARDS). DESIGN: Prospective, nonrandomized, interventional study. SETTING: Medical and surgical intensive care units at a university tertiary care center. PATIENTS: Twelve patients with ARDS and severe hypoxemia, defined as

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P_{aO_2}/F_{IO_2} of ≤ 150 and F_{IO_2} of ≥ 0.6, with pulmonary artery occlusion pressure of < 18 mm Hg. INTERVENTIONS: Inhaled nitric oxide (20 parts/million for 15 min) in the supine and prone position, and intravenous almitrine bismesylate while prone (1 mg/kg/hr for 60 mins), alone or combined with nitric oxide. MEASUREMENTS & MAIN RESULTS: Hemodynamic, blood gas, and gas exchange measurements were performed at sequential time points as follows: (a) baseline supine; (b) nitric oxide in the supine position; (c) after return to baseline supine; (d) after 30 minutes prone; (e) after 120 minutes prone; (f) nitric oxide while prone; (g) after return to baseline prone; (h) almitrine bismesylate prone; and (i) nitric oxide and almitrine bismesylate combined, for 15 minutes prone. Patients were considered responders to the prone position if a gain in P_{aO_2} of ≥ 10 torr (≥ 1.3 kPa) or a gain in the P_{aO_2}/F_{IO_2} ratio of ≥ 20 was observed. Seven patients (58%) responded to being turned prone. Compared with supine baseline conditions, nitric oxide and supine position increased arterial oxygen saturation from 89 ± 4 (SD) % to 92 ± 3% ($p < 0.05$) and nitric oxide plus prone position increased arterial oxygen saturation (94 ± 3% vs 89 ± 4%, $p < 0.05$) and decreased the alveolar-arterial oxygen difference from 406 ± 124 torr (54 ± 16 kPa) to 387 ± 108 torr (51 ± 14 kPa) ($p < 0.05$). Almitrine bismesylate increased P_{aO_2}/F_{IO_2} versus baseline (122 ± 56 vs 84 ± 21, $p < 0.05$). Almitrine bismesylate decreased the alveolar-arterial oxygen difference versus baseline from 406 ± 124 torr (53.9 ± 16.5 kPa) to 386 ± 112 torr (51.3 ± 14.8 kPa) and versus nitric oxide and supine position from 406 ± 111 torr (53.9 ± 14.7 kPa) to 386 ± 112 torr (51.3 ± 14.8 kPa) ($p < 0.05$). Prone position alone did not improve oxygenation. However, the combination of nitric oxide and almitrine bismesylate increased P_{aO_2}/F_{IO_2} versus nitric oxide supine and nitric oxide prone conditions (147 ± 69 vs 84 ± 25 and 91 ± 18, respectively; $p < 0.05$). In patients responding to the prone position ($n = 7$), combining nitric oxide and almitrine bismesylate led to further improvement in P_{aO_2} compared with the prone position alone, with P_{aO_2} increasing from 78 ± 12 torr (10.3 ± 1.6 kPa) to 111 ± 55 torr (14.7 ± 7.3 kPa) ($p < 0.05$), which was not the case when either nitric oxide or almitrine bismesylate was added separately. Heart rate and cardiac output were increased by almitrine bismesylate compared with all other measurements. Mean pulmonary arterial pressure was decreased by nitric oxide (27 ± 7 vs 30 ± 7 mm Hg nitric oxide supine vs baseline supine and 29 ± 7 vs 33 ± 8 mm Hg nitric oxide prone vs baseline prone, $p < 0.05$) and increased by almitrine bismesylate (36 ± 9 vs 30 ± 7 mm Hg baseline supine, 27 ± 7 mm Hg nitric oxide supine, 33 ± 8 mm Hg baseline prone, and 29 ± 7 mm Hg nitric oxide prone; $p < 0.05$). The increase in mean pulmonary arterial pressure was totally abolished by nitric oxide (31 ± 5 vs 36 ± 9 mm Hg, $p < 0.05$). Minute ventilation, respiratory system compliance, physiologic deadspace, and P_{aCO_2} remained unchanged. CONCLUSION: In ARDS patients with severe hypoxemia, arterial oxygenation can be improved by combining the prone position, nitric oxide, and almitrine bismesylate, without deleterious effects.

Low-Dose Methotrexate Spares Steroid Usage in Steroid-Dependent Asthmatic Patients: A Meta-Analysis—MG Marin. Chest 1997;112 (1):29.

OBJECTIVES: To determine if treatment with low-dose methotrexate spares oral steroids in adult, steroid-dependent, asthmatic patients. DESIGN:

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Articles identified by computer search were excluded if they (1) did not contain original data relating to the primary question, (2) had no controls, or (3) described subjects younger than 18 years of age. MEASUREMENTS: From each article, the following was abstracted: reference citation; type of control; whether study incorporated a run-in period in which the baseline level of prednisone was reduced to the lowest possible dose; dosage and length of methotrexate therapy; baseline dosage; and type of steroid. Also, the following was determined during both placebo and methotrexate arms of each study: steroid dosage, FEV_1, serious side effects, and alteration in level of serum aspartate aminotransferase. RESULTS: Eleven eligible studies were identified. Methotrexate treatment resulted in a decrease in prednisone or prednisolone usage by an average of 4.37 mg/d or 23.7% of the initial dosage. The summary effect size in standard deviations (SDs) was −0.53 (95% confidence interval = −0.29 to −0.77). Subgroup analysis showed that patients treated with prolonged (6-month) therapy with methotrexate, those with low long-term usage of steroids (≤ 20 mg/d), and those whose study design incorporated a run-in period, tended to have the greatest steroid-sparing effects with methotrexate. CONCLUSIONS: Low-dose methotrexate has a significant steroid-sparing effect in steroid-dependent asthmatic patients. The greatest effect was evident in patients in whom an effort was made to reduce baseline steroid dosage and in whom methotrexate was used for 24 weeks. *See the related editorial:* ***Methotrexate Revisited*** *–MF Mullarkey. Chest 1997;112 (1):1-3.*

Comparison of Pressure- and Flow-Triggered Pressure-Support Ventilation on Weaning Parameters in Patients Recovering from Acute Respiratory Failure—AS Tütüncü, N Çakar, E Çamci, F Esen, L Telci, K Akpir. Crit Care Med 1997;25(5):756.

OBJECTIVE: To compare the effects of pressure- and flow-triggered pressure-support ventilation on weaning parameters during recovery from acute respiratory failure. DESIGN: Prospective, randomized, clinical trial. SETTING: Intensive care unit in a university hospital. PATIENTS: Sixteen orotracheally intubated adult patients recovering from acute respiratory failure of various etiologies, without chronic obstructive pulmonary disease. INTERVENTIONS: Randomized application of pressure- and flow-triggered pressure support ventilation at 100% and 75% ventilatory support levels in each triggering system. A total of 4 conditions were applied for 30 minutes each in all patients. MEASUREMENTS & MAIN RESULTS: Ventilatory, respiratory, and hemodynamic data were measured. For the measurement of weaning parameters, pressure and volume signals were directed to a computerized respiratory monitor by means of an esophageal probe and a flow sensor between the 'Y' piece of the ventilatory circuit and the endotracheal tube. During both pressure-triggered (trigger sensitivity of −1 cm H_2O) and flow-triggered (trigger sensitivity of 0.7 to 2.0 L/min) pressure-support ventilation with a ventilator, peak airway pressures were applied so as to decrease the work of breathing performed by the patient to zero (full ventilatory support). Partial ventilatory support was applied at 75% of the peak airway pressures achieved during full ventilatory support with each triggering system. A total of 4 experimental conditions were evaluated at identical F_{IO_2} and positive end-expiratory pressure levels during pressure-support ventilation in each patient. Total ventilation volumes, arterial blood gas data, and hemodynamics did not differ among the 4 experimental conditions. During partial ventilatory support, the work of breathing, rapid shallow breathing index, and esophageal pressure increased significantly with both triggering systems when compared with data obtained at full ventilatory support. The mean data for the weaning parameters during the condition of partial ventilatory support were comparable between pressure- and flow-triggered pressure-support ventilation (ie, 0.38 ± 0.24 vs 0.42 ± 0.26 joule/L for work of breathing, 2.6 ± 1.6 vs 3.3 ± 1.7 cm H_2O for tracheal occlusion pressure; and 40.2 ± 12.9 vs 50.4 ± 18.3 breaths/min/L for rapid shallow breathing index, respectively). CONCLUSIONS: The application of either a pressure- or flow-triggered system during pressure-support ventilation with the ventilator did not significantly affect short-term changes in gas exchange, respiratory mechanics, and inspiratory workload in patients recovering from acute respiratory failure of various etiologies without chronic obstructive pulmonary disease.

A Comparison of Double-Strength Beclomethasone Dipropionate (84 μg) MDI with Beclomethasone Dipropionate (42 μg) MDI in the Treatment of Asthma—RA Nathan, KB Nolop, FM Cuss, RR Lorber. Chest 1997;112(1):34.

OBJECTIVE: To compare the efficacy and safety of a double-strength formulation of beclomethasone dipropionate (BDP 84) metered dose inhaler (MDI) with that of beclomethasone dipropionate (BDP 42) MDI in the treatment of chronic asthma. DESIGN: A 28-day, randomized, double-blind, double-dummy, placebo-controlled, multicenter study. SETTING: Outpatient. PATIENTS: A total of 423 patients aged 12 to 65 years (mean range, 34 to 36 years) with moderate asthma (FEV_1, 50 to 80% of predicted) who required long-term inhaled corticosteroids were enrolled. INTERVENTIONS: Patients were randomized to receive BDP 84, 2 oral inhalations bid (336 μg/d), BDP 42, 4 oral inhalations bid (336 μg/d), or placebo. A fourth treatment arm administering BDP 84, 8 oral inhalations bid (HD BDP 84; 1,344 μg/d) was also included to determine whether a dose-response relationship could be demonstrated. MEASUREMENTS: Spirometry, clinical observations. RESULTS: The 3 active treatments were significantly more effective ($p \leq 0.01$) than placebo at all time points in improving FEV_1, the primary efficacy parameter; BDP 42 and BDP 84 were comparable to each other at every time point. Secondary pulmonary function tests (FVC, forced expiratory flow at 25 to 75% of FVC, and peak expiratory flow rate) showed similar results. All 3 active treatments were well tolerated. A dose response between 336 μg/d and 1,344 μg/d was demonstrated. CONCLUSION: In this well-controlled 28-day study, BDP 42 and BDP 84 were shown to be comparable in efficacy and safety on a microgram-for-microgram basis. *See the related editorial:* ***Asthma Therapy: What's New and Is It Necessarily Better?*** *–JW Georgitis. Chest 1997; 112(1):3-5.*

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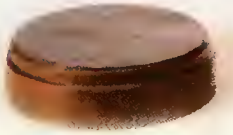

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Pat Brougher RRT—We Owe Her Much

It is with great sadness and admiration that I write this editorial about a unique respiratory therapist, Pat Brougher RRT, until last month the Editor of a unique journal, RESPIRATORY CARE. Although Mrs Brougher will continue to assist the Journal and the AARC with the 1997 OPEN FORUM, the 1997 Journal Conference, and the ever-important Clinical Practice Guidelines, her stepping aside from the editorship marks a major milestone, not only in the history of the Journal (which has had only four editors since it first appeared 41 years ago), but also for the respiratory care profession.

Tremendous, positive change has occurred during Mrs Brougher's 11-year tenure as Editor. RESPIRATORY CARE's circulation has increased steadily, paralleling the growth in AARC membership, from approximately 25,000 in 1986 to 40,000 today—giving it the largest circulation of any peer-reviewed periodical in the respiratory care field. The Journal reaches most major health care-related institutions in the U.S., be they academic medical centers; public, private, and government acute-care hospitals; subacute and long-term care facilities; managed care organizations; individual clinics; home care agencies; or schools—and has a steadily increasing circulation elsewhere both in North America and abroad.

This Journal enjoys a respected position as promulgator of state-of-the-art education and reference materials in its field. Particularly strong during Mrs Brougher's editorship have been articles, symposia, and special issues focusing on applied respiratory science: mechanical ventilation, clinical assessment and monitoring, aerosol therapy, and the organization and delivery of respiratory care services, among other topics of practical importance to clinicians dealing with respiratory patients. Under the guidance of the Editorial Board, she has continued the journal conference series begun during the editorship of the late Phil Kittredge RRT, and these have generated unmatched resource documents for clinicians everywhere—not only respiratory care practitioners but also physicians, nurses, physical therapists, students, and others. These documents offer practical guidance for the bedside as well as authoritative theoretical and empirical foundations.

A major contribution for which Mrs Brougher's stewardship of the Journal will be remembered, one whose influence has already extended well beyond the respiratory care profession, is the American Association for Respiratory Care (AARC) Clinical Practice Guidelines (CPGs). Mrs Brougher played a crucial role in the planning, development, writing, and publication of the CPGs, of which the Journal has now published a total of 46 since 1991. The recent proliferation of CPGs in all fields of health care has raised hackles and spawned heated controversy, but while it can be argued that such guidelines often fall short of the goals of evidence-based medicine, they go a long way toward promoting safe patient care and establishing sometimes much-needed practice standards.

Most of all, though, in my opinion, Pat Brougher's contribution as Editor has been the growth of the RESPIRATORY CARE OPEN FORUM, the AARC's annual publication and presentation at its annual meeting of abstracts reporting original research in the field. Someone seeking evidence of high-caliber science in the Journal need look no further than its OPEN FORUM. In 1976 (the year I first became an AARC member), the Association's annual convention featured the presentation of 19 abstracts of original research. By 1986, when Mrs Brougher became Editor, the annual number of presented abstracts was 70; the number for 1996 was more than 130. Today the OPEN FORUM attracts hundreds of submissions from around the world, has an acceptance rate the same as (or a bit lower than) those of the major medical specialty societies, and attracts overflow crowds to several large rooms for simultaneous sessions throughout the duration of the convention.

An examination of recent OPEN FORUM abstracts, in comparison with those of a decade or two ago, provides convincing evidence of the increased scientific awareness and sophistication of their author-presenters—and also of their increased diversity. In 1996 two-thirds of the OPEN FORUM abstracts had physician co-authors, and 11 were presented by physicians; 6 were presented by other non-RCPs, and 14 abstracts came from countries other than the U.S. The tremendous growth, outstanding quality, and increasing diversity of the OPEN FORUM of the 1990s reflect in part the continued evolution of the field, but are owed primarily to the tireless efforts of Pat Brougher.

Guided by its Editor, RESPIRATORY CARE continues to maintain high standards for the original research reported in its pages. Anyone who has submitted research papers both to this journal and also to other publications in the field can vouch for this. Especially in recent years, the process of reviewing and revising manuscripts has been, if anything, more rigorous for RESPIRATORY CARE than for other journals.

It is a great honor for me to succeed Pat Brougher as Editor, although it is also an enormous challenge. While she will continue to assist the Journal and the AARC, her departure as Editor leaves a huge gap to fill. She is to be congratulated for all her many accomplishments in the field, and I know I am joined by the members of the Editorial Board, the Section Editors, and RESPIRATORY CARE's thousands of contributors and readers in wishing her good health and much happiness in the coming years. We will all continue to benefit from her vision and guidance.

David J Pierson MD
Editor
RESPIRATORY CARE

Respiratory Care Education: Quo Vadis?

The role of the respiratory care practitioner has experienced a dramatic change in the past three years.[1] Managed care has swept across the country, acute care facilities have been drastically downsized, and home care has grown. In the past and during this period of profound change in the structure of health care delivery the question arises, Are new graduates of respiratory programs adequately prepared to enter the work force? Perhaps equally as important is the question, Are practitioners currently in the work force able to cope with the changes being imposed on them?

First and foremost, we must provide a relevant curriculum to our students. Curriculum reviews cannot be scheduled for 3- to 5-year intervals. Continuous quality improvement should be a factor in the management of the curriculum. Just how active is your curriculum review committee? Do you listen to employers and the needs they are voicing? Your graduates may have a 100% pass rate on the entry-level National Board for Respiratory Care examination, but how much additional training must be provided by employers in order to make those same graduates productive employees? Also, this education must be more problem-focused, linked to situations people will be confronted with in their work setting, and not as discipline- and theory-focused.[2] Theories must be linked to daily practice.

Students must be given the broad view of health care systems with emphasis on the continuum of care from acute care, to skilled nursing facilities, to home care, and every step along the way, in order to understand managed care and how it will affect them.[3] Building a core curriculum shared by other health disciplines is key in establishing the interdisciplinary care team found in the work force. An understanding of the role of each member of the team is crucial to understanding the contribution each makes to patient care. Clinical experiences should be structured in such a way as to offer interdisciplinary team work while still in school. Likewise those clinical experiences must be provided in settings across the continuum of care. Students should also be exposed to community activities, health promotion and disease prevention, community-based services, and home care. Much has been written about multiskilling for the respiratory care practitioner to survive in the workplace of the future. In this issue, Hoberty[4] reports on a survey of program directors, conducted to determine the extent of multiskilling education incorporated into entry-level programs. The numbers are not encouraging. In view of chronic complaints of insufficient time in current curriculums or legislatively mandated limitations in course length this is not surprising. Perhaps of greater interest would be the questions, "How many programs are offering postgraduate short courses to help practitioners already in the field?" "What skills are being taught?" "At night?" "On weekends?" "On campus?" "At the work site?"

In order to function in this new order students must have well-developed critical-thinking skills and communications skills. Ward and Plevak[5] report how they stimulate critical-thinking skills among students and the benefits students derive in the course of developing research skills. Working with other members of the health care team, patients, and their families demands these skills. Use of patient-driven protocols requires practitioners who can collect data, interpret it, and act upon it. They must be fully computer literate; and, it is fortunate, secondary schools are better preparing graduates in this regard. Perhaps a self-examination is called for—Is the faculty prepared and qualified to teach critical thinking?

The associate degree as a requirement for entry to practice will help students entering the educational stream, but what of practitioners in the field today? It is incumbent on educational institutions to be responsive to the needs of practitioners and employers alike. They must be flexible in delivering stand-alone, skill-building courses at night and weekends, either on campus or in the workplace. Practitioners today must be committed to lifelong learning or they will be overtaken by events, whether it is restructuring or downsizing. The addition of skills adds value to what they can bring to the work site. Employers are not educators and they are clamoring for the schools to meet the gap existing between the current skills inventory and the demands of the current health care system.

Quo vadis? Where are you going?

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REFERENCES

1. Dubbs WH, Weber K. AARC Survey measure effects of restructuring on respiratory care nationwide. AARC Times 1996;20(3):29-40.
2. Mishoe SC, MacIntyre NR. Expanding professional roles for respiratory care practitioners. Respir Care 1997;42(1):71-86.
3. Durbin CG Jr. The role of the respiratory care practitioner in the continuum of disease management. Respir Care 1997;42(1):159-165.
4. Hoberty PD. The extent of multiskilling education in the curricula of respiratory therapy education programs: a national survey. Respir Care 1997;42(9):849-857.
5. Ward J, Plevak DJ. An educational strategy: research methods and abstracting skills. Respir Care 1997;42(9):845-847.

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An Educational Strategy: Research Methods and Abstracting Skills

Some years ago we wrote an editorial that testified to the value of writing as a learning strategy.[1] After faculty modeled the exercise, students were required to complete a short paper, ie, Test Your Radiologic Skill, Blood Gas Corner, Pulmonary Function Test Corner, or case study, during their final academic quarter.[2] Using this approach, our 2-year community college-based program hoped to accomplish several goals:

- Exercise the English composition skills of our students and apply those skills to writing a manuscript suitable for publication
- Engage students in a creative project that encouraged critical thinking
- Challenge students in several aspects of cognitive ability: knowledge, comprehension, application, analysis, synthesis, and evaluation
- Help students become 'experts' in an area of respiratory care
- Guide students through an array of tasks—from selecting an appropriate case to searching the literature, analyzing diagnostic tests, writing a manuscript, and interacting with the Journal's editorial office

By introducing our students to professional journalism, we hoped to build their confidence while encouraging them to engage in such activities throughout their professional careers. Those who had their papers published, documented their ability to extend themselves beyond the school into the respiratory care and scientific community; our program continues to use this learning strategy.[3-12] We have also encouraged our affiliated hospital departments to use similar strategies to facilitate academic pursuit after formal training has ended.

Recently, the program's faculty recommended that we redesign an existing seminar to resemble a journal-club format. Our objective was to equip students with skills to critically evaluate the research-based medical literature. Our goal was to help them decipher the topics of null hypotheses, p values, statistical power, and research method. After we examined the evaluations from our first class, we realized that something was missing. The students had played only a passive role in a class that was asking them to become critical thinkers. We failed to provide an active experience; the analogy: we were telling them to learn to cook without letting them in the kitchen. We determined to provide an active component to their education in research-based journalism by including a class research project to complement the journal club.

We used a problem-based learning approach and gave the class the objective of conducting original research and producing an abstract worthy of submission to a scientific, respiratory care journal. There were always at least a few students in each class who could stimulate thinking. Our experience was that students seem to have a knack for finding the unanswered questions in respiratory care. The trick for the faculty was to help them select research that could be completed in the final 5 weeks of the course. Perhaps they could get into the kitchen and learn to *boil water*.

The initial process began with topic discussions and literature searches. Invariably the students needed to be reminded of the realities of time and equipment access. After a topic was chosen, the class was divided into smaller work groups. Timelines were set, and necessary resources located. Permission was obtained through institutional channels. The medical director helped with the research protocol and coached the students through tasks of data collection and analysis. The painful task of writing the abstract occupied the final class meetings. Although there was an abstract-writing team, the entire class helped with the final editing.

For each class the project became a labor of love. Every student participated in the scientific method of hypothesis generation, study design, data collection, and analysis. In the end, all of the students realized the tremendous work involved in performing such projects. The event also promoted successful attributes of working within a group. At the graduation ceremony, each student proudly received a copy of the abstract along with their diploma and certificate of completion. The final draft was later submitted to the RESPIRATORY CARE OPEN FORUM.[13]

Our faculty learned that problem solving is not a skill that is well taught by didactic instruction. The latter strategy usually requires that students only listen. In general, learning is not a spectator sport. Educational psychologists have associated improved learning with active participation.[14] Research is one method to cultivate the many components of critical thinking: curiosity, healthy skepticism, awareness, reflection, analysis, argumentative capacity, and honesty.[15]

In the past, conducting original research was almost exclusively part of graduate degree academics or an industry-related

activity. Most perceived scientific investigation as being conducted by upper crust intellectuals—such as Dr Zarkov, Dr Spock, Comdr Data or Tuvok, (depending on your position in the time-continuum). However, medicine is changing. Today, the scientific method is being utilized throughout health care not only as a mechanism of clinical investigation but also as a means of providing quality control in the laboratory or clinical setting. The classroom is an excellent setting for the student to become acquainted with the scientific method. Readers of this Journal may be familiar with other articles co-authored by baccalaureate student-authors using similar strategies.[16-19] This foundation can be further developed throughout the career of the practitioner.

The Editorial Board of RESPIRATORY CARE has been active in spreading this message to both clinicians and educators. The Journal has published articles concerning the logistics of performing research, it sponsors the OPEN FORUM, and holds continuing education events intended to develop researchers.[20-21] The American Respiratory Care Foundation allocates financial rewards and grants for deserving researchers.

Currently the profession of respiratory care is "raising its educational bar," as the associate degree becomes the entry level and baccalaureate programs proliferate. As required curriculum expands, it seems reasonable to teach the scientific method to our students. Student research resembles patient case studies and simulated patient management problems in that it introduces and exercises skills that are utilized every day in the workplace. Each day the respiratory care practitioner (RCP) confronts new patients with different problems. These problems need to be identified, evaluated, and analyzed before proper decisions are made. Without this approach, students are poorly prepared to perform patient assessments, implement therapist-driven protocols, or act as case managers.[22] The AARC (American Association for Respiratory Care)-sponsored Educational Consensus Conferences have identified future trends that will require practitioners to possess a broader education in the arts and sciences, and enhanced communication and analytical skills.[23,24] We feel that familiarization with the scientific method will constitute an important aspect of the future RCP's education background.

Nine years ago Dr David Pierson challenged the readers of this Journal, "...Respiratory care can function as a science and that there can be a New Age of formal studies and everyday care conducted according to the scientific approach."[25] A more recent editorial has restated some of these themes in suggesting that both formal education and staff development be expanded to accommodate current and future challenges.[26]

The AARC and other professional organizations expend significant resources in providing clinical practice guidelines to anchor our tasks/procedures in science.[27] National organizations such as the American Heart Association and the National Heart, Lung, and Blood Institute provide comprehensive strategies based on research projects.[28-30] Our clinical practice is already based on considerable scientific evidence. However, in order to usher our profession into the next millennium, we will need to embrace the scientific method in our every day practice. We must equip current and future generations of RCPs with an expanded knowledge base and skills, which include the ability to participate in and conduct research. Familiarity with the scientific method can have its origins in a respiratory care educational program through class research projects.

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REFERENCES

1. Ward JJ. Strategy for learning: submit a paper [editorial]. Respir Care 1985;30:673-674.
2. Ward JJ. What's in this lady's chest? [TYRS]. Respir Care 1984;27 (2):164-166.
3. Davies R. Hemoptysis from normal lung? [TYRS] Respir Care 1985;30(1):49-50.
4. McCallum BK. An unnecessary problem in the intensive care unit [TYRS]. Respir Care 1985;30(4):277-278.
5. Awan ZI, Didier EP. Methemoglobinemia? [Blood Gas Corner]. Respir Care 1988;33(5):363-364.
6. Voges R, Wilson G, Johnson S. Acute deterioration of a second twin [TYRS]. Respir Care 1987;32:1070-1075.
7. Belda TE. A hyperlucent lesion in an assymptomatic patient [TYRS]. Respir Care 1988;33(12):1141-1142.
8. Webber KL, Heim KR. Baby, why are you so tired? [TYRS]. Respir Care 1991;36(2):116-117.
9. Copeman SE. Stumped in the ICU [TYRS]. Respir Care 1992;37 (5):458-461.
10. Gebling S. Pulmonary pathology following intra-abdominal surgery. [TYRS]. Respir Care 1994;39(1):70-73.
11. Jung S. What's with is massive hemoptysis? [TYRS]. Respir Care 1997;42(6):620-622.
12. Kramer C, Buck C, Plevak D, Schroeder D, Ward J. Do tape and repeated sterilization effect the accuracy of disposable pulse oximetry probes? [abstract]. Respir Care 1995;40(11):1201.
13. Boynton B, Jung S, Nelson S, Potts C, et al. 0-16 L/min oxygen flowmeters are not accurate in delivering low-flow oxygen [abstract]. Respir Care In press 1997.
14. Active learning: creating excitement in the classroom. Washington DC: The George Washington University School of Education and Human Development; 1991.
15. Brookfield SD. Developing critical thinkers. San Francisco: Jossey-Bass; 1987.
16. Hess D, Ness C, Oppel A, Rhoads K. Evaluation of mouth-to-mouth ventilation devices. Respir Care 1989;34(3):191-195.
17. Hess D, Horney D, Snyder T. Medication-delivery performance of eight small-volume, hand-held nebulizers: effects of diluent volumes, gas flowrate and nebulizer model. Respir Care 1989;34(8):717-723.
18. Hess D, Goff G, Johnson K. Effect of hand size, resuscitator brand,

and the use of two hands on volumes delivered during adult bag-valve ventilation. Respir Care 1989;34(9):805-810.
19. Hess D, McCurdy S, Simmons M. Compression volume in adult ventilator circuits: a comparison of five disposable circuits and a nondisposable circuit. Respir Care 1991;36(10):1113-1118.
20. American Association for Respiratory Care. Fundamentals of respiratory care research: parts 1 and 2. AARC annual meeting, Atlanta: December 7, 9, 1991.
21. American Association for Respiratory Care. Special research program. AARC annual meeting, San Antonio, Texas: December 15, 1992
22. Meredith RL, Pilbeam SP, Stoller JK. Is our educational system adequately preparing respiratory care practitioners for therapist-driven protocols? [editorial]. Respir Care 1994;39(7):709-711.
23. Proceedings of a national consensus conference on respiratory care education. Year 2001: Delineating the educational direction for the future respiratory care practitioner. Dallas: American Association for Respiratory Care; 1993.
24. Proceedings of the second national consensus conference on respiratory care education. Year 2001: an action agenda. Dallas: American Association for Respiratory Care; 1993.
25. Pierson DJ. Respiratory care as a science. Respir Care 1988;33(1): 27-37.
26. Kester L, Stoller JK. Respiratory care education: current issues and future challenges. Respir Care 1996;41(2):98-99.
27. Hess DR. The AARC clinical practice guidelines. Respir Care 1991; 36(12):1398-1401.
28. Emergency Cardiac Care Committee and Subcommittees, American Heart Association. Guidelines for cardiopulmonary resuscitation and emergency cardiac care. JAMA 1992;268:2172.
29. National Asthma Education and Prevention Program, National Heart, Lung, and Blood Institute. Expert panel report II: guidelines for the diagnosis and management of asthma. U.S. Department of Health and Human Services; 1997.
30. Petty TL, Weinmann GG. Building a national strategy for the prevention and management of and research in chronic obstructive pulmonary disease: National Heart, Lung, and Blood Institute workshop summary. JAMA 1997;277:246-253.

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AARC

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Anything Else?

The conflict concerning respiratory care education is over for now, and we can settle down to facing future problems. The body of knowledge to be mastered by respiratory therapy practitioners has grown, and one year is no longer adequate for teaching if anything else is to be learned. Question is what is the 'anything else?'

A partial answer is 'humanity,' in the sense of compassion, understanding, and sympathy; in other words understanding of and sympathy for ones fellow man. These are necessary in the care of the sick. Thus, technical knowledge is not enough. How can this be learned by those of us already knowledgeable in technical aspects, and what courses can fill this part of 'anything else?'

All of us learn from our families, our peers, and our technical teachers, but wisdom of the ages is stored in literature. Writings that have lasted have the characteristic that the happenings and emotions described illustrate and lead to understanding of the human condition.

Have you ever read out loud so you can hear the speeches of a play by Shakespeare? Try the King James version of the Bible. These as well as all lasting literature give us understanding and can add to our knowledge of ourselves and our patients. Read, read, read!

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Editor's Note: The following poems are reprinted, with permission of the author, from the booklet, *Poems Are An Author's Way*, by H F Helmholz Jr MD. The booklet is available from the Lambda Beta Honor Society for Respiratory Care, PO Box 15945-292, Lenexa KS 66285. Donations for the booklet support the organization's scholarship fund.

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Message To A Graduating Class

Remember that you can't remember
Everything we've said,
But you will be some surprised
How much is in your head;
And there's capacity for more,
Learn something every day;
It isn't hard for what you do
Will teach you 'long the way.
When ears and eyes and mind are open
Now you working R.T. creatures
Will earn and learn and pretty soon
You'll know more than your teachers.

None Should Fail

Exams are never easy,
They are not meant to be;
But when you're ready for them,
They're not so bad, you see.
So how can one get ready,
Is there a useful rule?
There really is no ready
Substitute for school.
So having done one's school work,
Why should any flunk?
Maybe your poor teacher
Was handing out the bunk.
But blame the school with care,
'Cause other students pass;
You forgot too much of what
Was handed out in class.
So spend some time in reading,
Don't put your notes away;
Review the little details
You do not use each day.
So if you fail the first time
Seek the remedy
For weaknesses reported by
The NBRC.

Multiskilling Education in the Curricula of Respiratory Therapy Education Programs: A National Survey

Phillip D Hoberty EdD RRT

BACKGROUND: National study commissions and professional associations, including the AARC, have suggested that allied health practitioners become multicompetent with their skills not limited to a single allied health profession. Hospital restructuring and elimination of central respiratory care (RC) departments have added to the pressure for multiskilled practitioners. I sought to determine the extent of multiskilling education (MSE) in the CAAHEP-approved RC programs. METHOD: Sixteen-item questionnaires were mailed to program directors at 377 institutions. Directors were asked to report on the amount of instruction in 10 skill areas: noninvasive and invasive cardiology, sleep disorders studies, neurodiagnostics, ECMO, bronchoscopy assisting, intravenous infusion, simple radiographic and medical laboratory procedures, and basic patient care skills. Directors were to identify the settings for instruction, type of faculty, and type of students. Directors were asked to speculate on MSE expansion during the next 12 months. RESULTS: 216 institutions (58%) representing 245 educational programs (representing 51% of accredited programs) responded. Commitment to MSE ranged from a high of 86% of programs offering some instruction in bronchoscopy assisting to a low of 7% of programs offering some instruction in performing radiographic procedures. Other MSE skills were instruction in sleep disorders studies (77%), invasive cardiology (71%), noninvasive cardiology (65%), basic patient care skills (40%), ECMO (37%), simple laboratory procedures (30%), infusion therapy (17%), and neurodiagnostics (13%). Differences ($p < 0.05$) between technician and therapist programs were significant. Directors in 51% of the programs indicated that within the next 12 months they intend to offer more MSE, with 36% at basic level skills only, 21% at advanced level skills only, and 43% at both levels. CONCLUSION: Although MSE has broad support in the literature, impact on the current curricula of approved RC programs is minor, with only a small portion of that instruction using the full range of instructional settings and faculty. Almost all MSE is directed toward those in or entering RC. About half of the directors reported plans to offer more MSE in the next year. [Respir Care 1997;42(9):849-857]

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Introduction

The respiratory care practitioner (RCP) of the future is likely to be a multiskilled, multicompetent professional who is expected to perform competencies beyond those in the traditional discipline.[1,2,3] This change will be in response to workforce restructuring and increasing demands for improved cost

containment, patient satisfaction, and quality of care.[4] Critics of allied health education respond that narrow, discipline-specific programs are not sufficient for this task; and that "we must focus allied health curriculum on related discipline clusters, multiskilling and interdisciplinary core curriculum."[5] To accomplish this change, health care workers must be provided with the knowledge, skills, and competencies necessary to practice effectively in the emerging multiskilled work environment. However, little is known about the extent of multiskilling education (MSE) in the curriculum of formal education programs for the preparation of the RCP.

Educators and clinical managers have been interested in MSE for some time. For at least 10 years considerable interest has been expressed in the literature about the training and utilization of the multiskilled health professional,[6] a person "...Cross trained to perform more than one function, often in more than one discipline. These combined functions can be found in a broad spectrum of health-related jobs ranging in complexity from non-professional to the professional level, including both clinical and management functions. The additional functions (skills) added to the original health care worker's job may be of a higher, lower, or parallel level."[6] Many respiratory care practitioners are participating in health care as multiskilled practitioners due to on-the-job preparation.[7,8,9] Hospital restructuring has been a powerful motivation for the RCP to take on additional duties that have not been a part of traditional respiratory care. In-house training programs in health care institutions have facilitated the acquisition of these new skills.[10] It is expected that continued, intense interest in cost containment will increase the training and utilization of multiskilled workers.[11] Educators in respiratory care have been challenged to do much more in the formal education programs to bring about the type of training the practitioner of the future is seen to require.[12]

I sought to determine the extent to which MSE is included in accredited respiratory therapy program curricula. The primary research question was: "What percentage of accredited respiratory care education programs offer MSE in non-traditional clinical skills?" Secondary questions addressed the settings, instructors, and recipients of MSE and the plans of program directors to offer more MSE in the near future. I examined for differences in results based on the type of program offered (technician or therapist). The results of this study should be helpful to program directors who consider offering MSE and who plan to maintain, add, or delete clinical skills in the curricula of their programs.

Methods

I reviewed the literature to identify MSE clinical skills for inclusion in this study. Although several published sources address nontraditional competencies appropriate for enhancing or enlarging the role of the respiratory care practitioner, no list of skills could be identified as having universal support.[13-22] I composed a list of competencies identified in the respiratory care and allied health literature and asked a panel of 6 educators and practitioners in respiratory care and cardiology studies to review the list for content validity. Based on the input of these individuals, 10 MSE clinical skills and descriptors were developed for inclusion in the questionnaire. The 10 skills, with clarifying descriptors, are listed in Figure 1. A 16-item written questionnaire was developed to answer the research questions.

MSE Skills

1. **Noninvasive cardiology**—such as echocardiograms, Holter monitoring, exercise stress tests, impedance cardiology, cardiac rehabilitation
2. **Sleep disorders studies**—such as polysomnography studies, CPAP (continuous positive airway pressure)-level determination
3. **Neurodiagnostics**—such as electroencephalography
4. **Invasive cardiology**—such as assistance with heart catheterization and performing hemodynamic monitoring in ICU.
5. **Extracorporeal membrane oxygenation**
6. **Bronchoscopy**—such as assisting with flexible fiberoptic bronchoscopy in an outpatient or ICU setting
7. **Intravenous infusion**—such as inserting or removing IV catheters, starting or maintaining infusions, or administering medications
8. **Simple radiographic procedures**—such as chest radiographs or processing film
9. **Simple medical laboratory procedures**—such as phlebotomy or automated blood tests
10. **Basic patient care skills**—such as bed making, personal hygiene, and ambulating patients

Fig 1. MSE skills with descriptors as listed in the Survey Questionnaire.

The questionnaire was pilot tested on a group of respiratory therapy educators at several institutions. Based on their feedback, items on the questionnaire were revised for clarity. The final document was mailed to program directors of 377 CAAHEP (Commission for the Accreditation of Allied Health Education Programs)-accredited education programs listed in the June 1995 edition of *Respiratory Therapy Educational Programs* from the Joint Review Committee for Respiratory Therapy Education.[23] The questionnaire is included in the Appendix. Included with the questionnaire was a cover letter that explained the purpose of the study and a postage-paid return envelope. The questionnaire was coded to identify nonrespondents in case follow-up surveys were necessary.

Statistics were primarily descriptive in nature, with responses tallied, and total number of responses for each item reported. The significance of χ^2 was employed to compare the number of returns from technician and therapist programs to the

proportions in the population of programs and to determine differences between the responses of the 2 types of programs. Minitab Version 7.0 (Minitab Inc, State College PA) software was used for all statistical procedures.

Results

Of the 377 institutions contacted, 216 responded with usable questionnaires, giving a usable return rate of 58%. This represented 245 educational programs or 51% of the accredited programs. All statistics reported are based on n = 245. Of the responses, 28% were from technician programs, while 72% were from therapist programs. The number of responses from technician and therapist programs was not significantly different from the number of technician and therapist programs in the population ($\chi^2 = 1.45869$, D.F. = 1, $p = 0.2271$). Because of the technician and therapist program response pattern and because the initial response was > 50%, follow-up mailings were not employed.

Table 1 lists the program directors' responses to the amount of instruction in the 10 clinical skills. Programs offering instruction ranged from highest in bronchoscopy assisting (86.5%) to lowest in radiographic procedures (7.0%). No statistical differences were seen between technician or therapist programs for MSE in neurodiagnostics, infusion therapy, simple radiographic procedures, simple medical laboratory procedures, or basic patient care skills. Therapist programs were significantly more likely ($p < 0.05$) than technician programs to offer MSE in noninvasive and invasive cardiology, sleep disorders studies, extracorporeal membrane oxygenation (ECMO), and bronchoscopy assisting. Table 2 summarizes the χ^2 values and significance levels for this data.

Table 3 summarizes this data as to the percent of programs offering a course of 1 credit hour or more in this skill. Instruction at that level ranged from highest in invasive cardiology (7.3%) to lowest in both ECMO and bronchoscopy assisting (0.4%).

Table 2. Results of Testing Differences between Technicians and Therapists* Programs

Multiskilling Skill Area	Value of χ^2	Significance of χ^2
Bronchoscopy	11.087	< 0.001
Sleep Disorders Studies	40.353	< 0.001
Invasive Cardiology	66.834	< 0.001
Noninvasive Cardiology	20.328	< 0.001
Basic Patient Care Skills	2.581	< 0.200
Extracorporeal Membrane Oxygenation	19.763	< 0.001
Simple Medical Lab Procedures	3.079	< 0.100
Infusion Therapy	10.284	< 0.010†
Neurodiagnostics	0.198	< 0.800
Simple Radiography	0.129	< 0.700

* Degrees of freedom (D.F.) = 1 for all χ^2

† Although this value was statistically significant at $p < 0.05$, at least one cell had < 5 cases.

Table 3. Programs Offering Multiskilling Education as 1 Credit Hour Course or Group of Courses

Skill	Course Offering (%)
Invasive Cardiology	7.3
Noninvasive Cardiology	5.3
Simple Medical Laboratory Procedures	4.1
Infusion Therapy	2.9
Basic Patient Care Skills	1.6
Sleep Disorders Studies	1.2
Neurodiagnostics	0.8
Simple Radiography Procedures	0.8
Assisting with Bronchoscopy	0.4
Extracorporeal Membrane Oxygenation	0.4

Of the total instruction being offered, 14.5% comprised the traditional trinity of classroom, laboratory, and clinical instructional settings. All other instances of instruction were without at least one of these components. Program Directors

Table 1. Current Curricula of Programs Reporting Instruction in Multiskilling Education

Clinical Skill	Offered (%)	Minor Component of Course (%)	Major Component of Course (%)	1 Credit Hour Course (%)	Group of Courses or Track (%)
Bronchoscopy	86.5	60.4	25.7	0	0.4
Sleep Disorders Studies	76.7	63.3	12.2	0	1.2
Invasive Cardiology	71.4	28.6	35.5	6.9	0.4
Noninvasive Cardiology	65.3	42.0	18.0	4.9	0.4
Basic Patient Care Skills	39.9	29.2	9.1	1.6	0
Extracorporeal Membrane Oxygenation	37.4	36.6	0.4	0	0.4
Simple Medical Lab Procedures	29.5	19.7	5.7	3.3	0.8
Infusion Therapy	17.2	11.9	2.4	2.9	0
Neuro-diagnostics	13.4	12.2	0.4	0.4	0.4
Simple Radiography	7	4.5	1.7	0.4	0.4

reported that 38.9% of the instruction was offered by classroom plus clinical or classroom plus outside faculty. All other instances of instruction were by one type of instructor only.

About 99% of instruction was offered to those in the respiratory care community. That is, instruction was offered to students enrolled in the programs, program graduates, or practitioners in respiratory care. Fifty one percent of program directors reported they intended to offer more MSE in their curricula during the next 12-month period, with 36% of planned instruction in basic skills (which was defined on the questionnaire as Items 8-10, Figure 1), 21% being in more advanced skills (Items 1-7, Figure 1), and 43% being a combination of both levels. Type and age of program had no relationship to plans to offer more MSE. When the responses of directors of technician programs were compared to those of directors of therapist programs, directors of technician programs were more likely ($\chi^2 = 10.569$, D.F. = 2, $\alpha < 0.01$) to be planning MSE in basic skills only, while directors of therapist programs were more likely to be planning programs in a combination of basic and advanced skill levels. Advanced cardiac life support was the most common additional certificate offered by all programs. Three programs reported offering a certificate in cardiopulmonary technology.

Discussion

The primary limitation to this study is the lack of a nationally-accepted definition of MSE clinical skills. There may also be a response bias to the data in that respondents choose whether to participate in the survey. Their choices may be based on their general willingness to participate in surveys, perception of gain from participating, and level of interest in participation in MSE. Very little MSE is being offered in skills linked to other clinical allied health disciplines such as radiographic technology, clinical laboratory science, neurodiagnostics, or nursing. This finding may confirm speculation in the literature that licensure and practice barriers will restrict cross-discipline training in clinical skills. In general, the commitment to MSE appears to be in selected clinical skills, with that being, a very small portion of the total curriculum.

Based on present offerings, therapist programs are more likely than technician programs to offer MSE in more complex, high-tech skills of noninvasive and invasive cardiology, sleep disorders studies, ECMO, and bronchoscopy assisting.

Traditionally major curriculum components have been afforded three settings for instruction: classroom, laboratory, and clinical.[24] Results of the survey suggest that only a small portion (14.5%) of MSE instruction is offered in all three settings and a somewhat larger proportion (38.9%) with clinical or outside faculty supplementing the program faculty. One might speculate that, in addition to possible lack of student or community request for further instruction, causes of low program commitment to MSE might be that traditional methods are deemed inappropriate for instruction in nontraditional curriculum knowledge, skills, and competencies, that larger proportions of instructional resources for MSE are not available, or that faculty are either not available or require continuing education in order to offer instruction in these competencies.

MSE offered by respiratory care education programs is provided almost exclusively to those in or entering the respiratory care community. That is, by exclusion, little MSE is offered to those allied health practitioners outside of the discipline. Further study is required to determine factors that encourage or discourage programs to offer MSE to the larger health science community of professionals. Should practitioners press to improve clinical skills through upward vertical job enhancement when entry level requires at least 2 years of education? If the answer is yes, MSE will have to be conducted primarily as a post-two-year function. This supports the contention of the second Consensus Conference that for the most part the education of the multiskilled future practitioner will follow obtaining an associate degree.[3]

Although a majority of program directors report the intent to offer more MSE in the next 12 months, nearly half of program directors do not. The reader may speculate that if much MSE is currently being offered in the field of respiratory care, it is mostly conducted by other educational sources such as employers, seminars, and professional organizations.

In Conclusion

This descriptive study represents an initial national survey of MSE in the formal education programs of respiratory care. Although many accredited respiratory therapy programs are participating in MSE, instruction in some skills is far more extensive than in others. Some skills that have been identified as suitable for vertical or horizontal job enhancement for the RCP receive little instruction in these formal programs.[16]

Seen from the perspective of the proportion of schools offering instruction in the 10 MSE competencies, the percent of programs offering instruction at 1 credit hour or more of academic credit, the use of instructional settings, and the types of instructors employed, MSE represents a relatively minor component of the curricula of accredited respiratory therapy educational programs. Therapist programs, to a greater degree than the technician programs, plan to participate in MSE of the more complex competencies.

REFERENCES

1. American Association for Respiratory Care. The respiratory care practitioner as a multiskilled health care provider: A position paper prepared for the national conference on multiskilling and the allied health work force. Dallas: AARC; 1994.
2. American Association for Respiratory Care. A summary report prepared by the educational consensus conference steering committee. Year 2001: delineating the education direction for the future respiratory care practitioner. Dallas: AARC; 1992.

3. American Association for Respiratory Care. Year 2001: an action agenda. Dallas: AARC; 1993.
4. Pew Health Professions Commission. Health professions education for the future: Schools in service to the nation. San Francisco: Pew Heath Professions Commission; 1993.
5. Pew Health Professions Commission. Critical challenges: Restructuring the health professions for the twenty-first century. San Francisco: UCSF Center for the Health Professions; 1995.
6. Bamberg R, Blayney KD, Vaughan DG, Wilson BR. Multiskilled health practitioner education: a national perspective. Birmingham: National Multiskilled Health Practitioner Clearinghouse; 1989.
7. Bamberg R, Blayney KD. The history and current status of multiskilled health practitioners. In Blayney KD, editor. Healing hands: Customizing your health team for institutional survival. Battle Creek MI: WA Kellogg Foundation; 1992.
8. Andersen A, American Association for Respiratory Care. The scope of respiratory care practice. Dallas: AARC; 1992.
9. Harris JF. Will we take the high road? The respiratory care profession's approach to the future (editorial). Respir Care 1997;42 (7): 685-687.
10. Dubbs WH, Weber K. AARC survey measures effects of restructuring on respiratory care nationwide. AARC Times 1996;20(Mar.):29-40 passim.
11. Blayney KD. The future of the multiskilled health practitioner movement. In Blayney KD, editor. Healing hands: customizing your health team for institutional survival. Battle Creek MI: WK Kellogg Foundation; 1992.
12. Bunch D. NCAH provides direction for allied health professions Part 3: Improving educational preparation. AARC Times 1996;20(Mar):18-20.
13. Drumheller OJ. Review of the literature for cross-training and job redesign for respiratory care personnel in Florida acute care hospitals. Respir Care Educ Ann 1996;5:31-55..
14. Kester L, Stoller JK. Respiratory care in the adult non-ICU setting. Respir Care 1997;42(1):101-111.
15. Minkley PL. Integrating sleep medicine and technology in respiratory care education. AARC Times 1997;21(May):74-77.
16. Mishoe SC, MacIntyre NR. Expanding professional roles for respiratory care practitioners. Respir Care 1997;42(1):71-86.
17. Striplin T, Rocks W. Redesigning and implementing a multicompetency curriculum design. AARC Times 1997;21(Feb):28-30.
18. Hess DR. The role of the respiratory therapist in the intensive care unit. Respir Care 1997;42(1):116-124.
19. Branson RD, Meredith R. Role of the respiratory care practitioner in the emergency department. Respir Care 1997;42(1):141-145.
20. Shrake KL. Role of the respiratory care practitioner in the diagnosis of cardiopulmonary disease. Respir Care 1997;42(1):148-156.
21. Sheldon RL. RCP's can play an important role as physician extenders in pulmonary outpatient clinics. AARC Times 1996;20(Nov): 52-56.
22. Campbell J. Respiratory care services department expands its scope of services. AARC Times 1993;17(Jul):66-67.
23. Joint Review Committee for Respiratory Therapy Education. Respiratory therapy educational programs. Euless TX: JRCRTE; 1995.
24. Joint Review Committee for Respiratory Therapy Education. Essentials for educational programs for the preparation of respiratory therapists and technicians. Euless TX: JRCRTE; 1982.

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APPENDIX
Extent of Multi-Skilling in Respiratory Care Curricula

1. What is the CAAHEP accreditation status of your program?

   ___ Technician ___ Therapist

2. For approximately how many years has your program held this accreditation status?

   ___

3. At which level are graduates of your program prepared?

   ___ Entry level Practitioner ___ Advanced Practitioner

4. Please indicate whether these "non-traditional" skill areas are taught as a part of your Respiratory Care curriculum; and, if they are, who is the instructor, who are the students, and where is this instruction offered?

   The following definitions will be helpful in making choices:

• not offered	your program does not prepare individuals to routinely perform this skill.
• minor course component	only one or a few class hours of a course are offered in this skill.
• major course component	several class hours or a few weeks of a course are offered in this skill.
• full course	a full course equivalent to at least a semester or quarter hour of credit is offered in the skill.
• group of courses	a group of courses or "specialty track" is offered in this skill.

A. Non-invasive cardiology -- such as echocardiograms, Holter monitoring, exercise stress tests, impedance cardiography, cardiac rehab.

1. Commitment (please select one only):
   __ not offered __ minor component __ major component __ course __ group of courses
2. Where is this instruction offered?
   __ classroom __ clinical __ laboratory
3. Who is the instructor?
   __ RC program faculty __ RC clinical faculty __ other _____
4. Who are the students? (please mark all that apply):
   __ students in the regular R.C. curriculum If so,
   __ all students complete __ those who elect this training
   __ post-graduate RCP's only
   __ non-RC students or practitioners

B. Sleep disorders studies -- such as polysomnography studies, CPAP level determination

1. Commitment (please select one only):
   __ not offered __ minor component __ major component __ course __ group of courses
2. Where is this instruction offered?
   __ classroom __ clinical __ laboratory
3. Who is the instructor?
   __ RC program faculty __ RC clinical faculty __ other _____
4. Who are the students? (please mark all that apply):
   __ students in the regular R.C. curriculum If so,
   __ all students complete __ those who elect this training
   __ post-graduate RCP's only
   __ non-RC students or practitioners

C. Neurodiagnostics -- such as EEG's

1. Commitment (please select one only):
   __ not offered __minor component __major component __course __group of courses
2. Where is this instruction offered?
   __ classroom __ clinical __ laboratory
3. Who is the instructor?
   __ RC program faculty __ RC clinical faculty __ other _____
4. Who are the students? (please mark all that apply):
   __ students in the regular R.C. curriculum If so,
   __all students complete __ those who elect this training
   __ post-graduate RCP's only
   __ non-RC students or practitioners

D. Invasive cardiology -- such as assistance with heart catheterization and performing hemodynamic monitoring in ICU.

1. Commitment (please select only one):
   __ not offered __minor component __major component __course __group of courses
2. Where is this instruction offered?
   __ classroom __ clinical __ laboratory
3. Who is the instructor?
   __ RC program faculty __ RC clinical faculty __ other _____
4. Who are the students? (please mark all that apply):
   __ students in the regular R.C. curriculum If so,
   __all students complete __ those who elect this training
   __ post-graduate RCP's only
   __ non-RC students or practitioners

E. Extra-corporeal membrane oxygenation

1. Commitment (please select only one):
   __ not offered __minor component __major component __course __group of courses
2. Where is this instruction offered?
   __ classroom __ clinical __ laboratory
3. Who is the instructor?
   __ RC program faculty __ RC clinical faculty __ other _____
4. Who are the students? (please mark all that apply):
   __ students in the regular R.C. curriculum If so,
   __all students complete __ those who elect this training
   __ post-graduate RCP's only
   __ non-RC students or practitioners

F. Bronchoscopy -- such as assisting with flexible fiberoptic bronchoscopy in an outpatient or ICU setting.

1. Commitment (please select only one):
   __ not offered __minor component __major component __course __group of courses
2. Where is this instruction offered?
   __ classroom __ clinical __ laboratory
3. Who is the instructor?
   __ RC program faculty __ RC clinical faculty __ other _____
4. Who are the students? (please mark all that apply):
   __ students in the regular R.C. curriculum If so,
   __all students complete __ those who elect this training
   __ post-graduate RCP's only
   __ non-RC students or practitioners

G. Intravenous infusion -- such as inserting or removing IV catheters, starting or maintaining infusions, or administering medications.

1. Commitment (please select only one):
   __ not offered __minor component __major component __course __group of courses
2. Where is this instruction offered?
   __ classroom __ clinical __ laboratory
3. Who is the instructor?
   __ RC program faculty __ RC clinical faculty __ other _____
4. Who are the students? (please mark all that apply):
   __ students in the regular R.C. curriculum If so,
   __all students complete __ those who elect this training
   __ post-graduate RCP's only
   __ non-RC students or graduates

H. Simple radiographic procedures -- such as taking chest radiographs or processing film.

1. Commitment (please select only one):
   __ not offered __minor component __major component __course __group of courses
2. Where is this instruction offered?
   __ classroom __ clinical __ laboratory
3. Who is the instructor?
   __ RC program faculty __ RC clinical faculty __ other _____
4. Who are the students? (please mark all that apply):
   __ students in the regular R.C. curriculum If so,
   __all students complete __ those who elect this training
   __ post-graduate RCP's only
   __ non-RC students or practitioners

I. Simple medical laboratory procedures -- such as phlebotomy, performing automated blood tests

1. Commitment (please select only one):
   __ not offered __minor component __major component __course __group of courses
2. Where is this instruction offered?
   __ classroom __ clinical __ laboratory
3. Who is the instructor?
   __ RC program faculty __ RC clinical faculty __ other _____
4. Who are the students? (please mark all that apply):
   __ students in the regular R.C. curriculum If so,
   __all students complete __ those who elect this training
   __ post-graduate RCP's only
   __ non-RC students or practitioners

J. Basic patient care skills -- such as bed making, personal hygiene, and ambulating patients

1. Commitment (please select only one:
   __ not offered __minor component __major component __course __group of courses
2. Where is this instruction offered?
   __ classroom __ clinical __ laboratory
3. Who is the instructor?
   __ RC program faculty __ RC clinical faculty __ other _____
4. Who are the students? (please mark all that apply):
   __ students in the regular R.C. curriculum If so,
   __all students complete __ those who elect this training
   __ post-graduate RCP's only
   __ non-RC students or practitioners

5. **Does instruction in any of the above skills result in a separate certificate of completion or the ability to be credentialed outside Respiratory Care?**

What skill area?	Certificate or Credential?

6. **Do you have additional comments or clarifications of your responses?**

_____

_____

7. **In the next 12 months do you intend to offer more multi-skill education outside of traditional R.C.? (please circle which)**

Yes No

If yes, will this probably be more in the area of basic skills (like H-J above) or more advanced skills (like A-G), or both?

Basic Advanced Both

THANK YOU FOR YOUR TIME AND ASSISTANCE IN COMPLETING THIS QUESTIONNAIRE! Please return by March 20, 1996.

Practitioner Perceptions of Educational Needs and Effects of Respiratory Care Protocol Implementation: A Citywide Survey

Cheryll K Hagus EMBA RRT

BACKGROUND & INTRODUCTION: Respiratory care practitioners (RCPs) from 6 hospitals and all area pulmonary physicians formed a committee to implement respiratory care protocols in the 6 participating hospitals in Austin, Texas. Faculty members from a local baccalaureate respiratory care program were asked to assist with the assessment of educational needs and the development of an education program. METHODS & MATERIALS: A survey was conducted to determine from RCPs their knowledge and clinical experience levels and their perceptions of their educational needs and the possible effects of protocol implementation. Survey results were intended to guide the development of an orientation and retraining program that could be implemented in the 6 hospitals. RESULTS: On a scale of 1 to 4, with 1 being no knowledge of protocols, the mean response was 2.75 (SD 0.785). On a scale of 1 to 4, with 1 being no clinical experience, the mean response was 2.067 (SD 0.935). Of the respondents, 2.6% had no knowledge of protocols; however, 61.3% had little or no clinical experience. Of the responding RCPs, 45.3% were concerned that they would receive inadequate retraining prior to protocol implementation. The greatest educational needs were x-ray interpretation and pulmonary function test analysis skills. The survey identified groups within specific hospitals who felt utilization, productivity, and job security would be decreased by protocol implementation. CONCLUSION: Survey results can provide insight into practitioners' perceptions and help guide the development of an education program. [Respir Care 1997;42(9):858-867]

Introduction

In mid-1994, the Austin Area Respiratory Care Protocol Committee was formed with the goal of implementing protocols in area hospitals. Table 1 describes the 6 participating hospitals. Committee participants included the directors of pulmonary services, respiratory care representatives who would be facilitators for the education program and pilot project in each hospital, and all area pulmonary physicians. Three months after the committee meetings began, faculty members from the baccalaureate respiratory care program at Southwest Texas State University were invited to join. The 6 participating hospitals are clinical affiliates of this program. Faculty members were requested to assess educational needs and participate in the development of an education program that would be suitable for use at all 6 hospitals. It was anticipated that existing course materials could be adapted and utilized effectively in the retraining of the hospital respiratory care practitioners (RCPs).

The Austin Area Respiratory Care Protocol Committee successfully developed a universal Respiratory Care Assessment-Care Plan form and 6 protocols. With completion of the pro-

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Table 1. Description of Participating Hospitals and Survey Response

Hospital	Description	Survey Response No. Sent	No. Returned	Response Rate
A	350-bed, corporate owned & managed, not-for-profit	36	22	61%
B*	330-bed, community/corporate owned, corporate managed, for profit	24	13	54%
C†	210-bed, city owned, corporate managed, not-for-profit	35	22	63%
D‡	104-bed, corporate owned and managed, for profit	10	4	40%
E	165-bed, corporate owned and managed, for profit	10	8	80%
F§	65-bed, corporate owned and managed, for profit	13	6	46%
	Total	128	75	59%

*Formerly community owned and managed, not-for-profit.
†Formerly city managed.
‡Corporate ownership has changed.
§Corporate ownership has changed.

tocols, the next step was to develop and implement an education program. A literature search revealed that many authors stress the importance of the education program to the development of uniform skill levels [1-5] RCP acceptance and confidence levels[3] and physician confidence in the ability of RCPs to perform patient assessment and implement respiratory care orders are linked to retraining.[4] It was noted that department managers may be held liable in injury cases involving implementation of a respiratory care protocol by an inadequately trained practitioner.[5] The most commonly used adjective connected to a description of retraining programs was "extensive." It was clear that an effective education program would be one of the key elements in successful implementation of the respiratory care protocols.

Materials & Methods

Materials

Because the Austin area project encompassed 6 diverse health care institutions, a project to measure perceived educational needs, opinions, and attitudes of the involved RCPs was undertaken. The objectives of the project were (1) to identify the knowledge level and the extent of clinical experience with protocols among the targeted RCP population; (2) to identify, from the RCP's point of view, the extent of retraining necessary prior to protocol implementation; (3) to identify RCP opinions and attitudes on learning methods, barriers to implementation, and the potential effects of protocols prior to starting the retraining. The results were intended to guide the development of the education program and to determine to what extent each hospital's orientation program needed to be unique based on the input of its own RCP staff members.

A written survey was deemed to be the most desirable approach. The benefits of such an approach are (1) low cost; (2) good chance of getting truthful answers to sensitive questions; (3) opportunity for well thought out responses; and (4) elimination of potential bias in a face-to-face interview.[6] A literature search provided information for the development of the survey tool. The educational needs section was based on the Model Curriculum for Assessment Skills.[7] The opinion and attitude sections were based on conversations between the respiratory care program faculty representative developing the survey and RCPs in the participating hospitals. Papers that highlighted potential barriers to protocol implementation[3,8] and expected benefits of respiratory care protocols[9-12] were also utilized in the development of the survey tool. The survey is presented in Appendix 1.

Methods

The survey was distributed to each RCP employed in each of the 6 participating hospitals. Surveys were to be completed anonymously with RCPs indicating only their principal employer. Surveys were returned to a collection box in each hospital. Completed surveys were forwarded to the faculty representative for analysis. Table 1 also shows the number of responses and the percentage response from each hospital, and the totals for the 6 hospitals.

Statistical analysis was performed using SPSS (SPSS Inc, Chicago IL) for aggregate frequency distribution and descriptive statistics (mean, median, mode, minimum, maximum, and standard deviation). Frequency distribution by hospital was analyzed for some questions.

Results

The RCPs' ratings of their knowledge of respiratory care protocols is shown in Figure 1, with a mean (SD) of 2.75 (SD 0.785). Figure 2 shows how RCPs rated their clinical experience with protocols, with a mean of 2.067 (0.935). Of the 40.8% of RCPs who felt they had a fair amount of knowledge about protocols, 16.7% reported they had no clinical experience with protocols, 30% reported having minimum experience, and 50% reported having experience with 1 or 2 protocols. Only 3.3% reported having experience with 6 or more protocols. Of the 6 participating hospitals, only one had no RCPs reporting that they had never used a protocol in the clinical setting. In 2 hospitals, 50% of the RCPs reported having never used a protocol clinically.

Table 2 demonstrates how RCPs rated their perceived educational needs in 11 different topic areas deemed critical to the implementation of protocols. Overall, 45.3% of the responding RCPs indicated a concern that review and retraining would be inadequate. Two of the 6 hospitals had a considerably higher

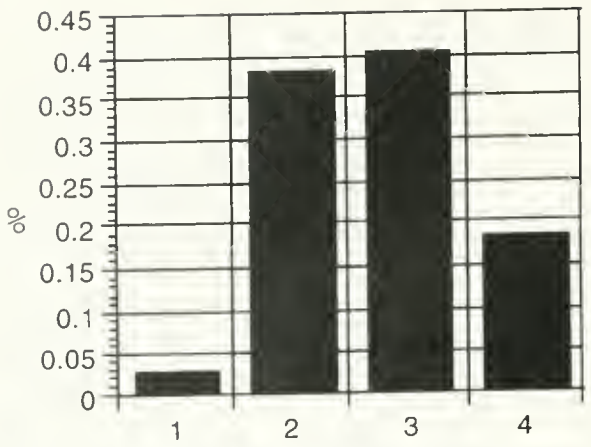

Fig. 1. The perceptions of respiratory care practitioners of their knowledge of respiratory care protocols (n = 75). 1 = no knowledge; 2 = minimal knowledge; 3 = fair amount of knowledge; 4 = A lot of knowledge.

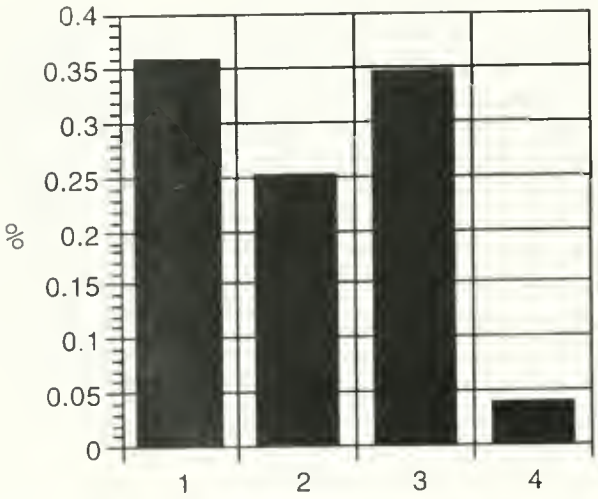

Fig. 2. Reported clinical experience of respiratory care practitioners with respiratory care protocols (n = 75). 1 = no clinical experience; 2 = minimal experience; 3 = experience with 1-2 protocols; 4 = experience with > 6 protocols.

number of YES responses to the question—72.7% and 75%. The YES responses in the remaining four hospitals ranged from 16.7% to 30.8%.

Figure 3 shows the preferred learning method when only 1 choice among 5 could be selected. Figure 4 shows how the 5 learning methods were ranked as alternate choices by the respondents.

Figure 5 shows what RCPs believed would be the biggest barrier to implementation of protocols in their respective hospitals. Overall, *physician acceptance* was ranked as the greatest potential barrier and *inadequate respiratory care staff* was ranked second. Of the 45.3% of RCPs who expressed concern that they would receive inadequate review and retraining (Question 4, Appendix 1), only 11.8% of them selected RCP review/retraining as the biggest barrier to implementation. Figure 6 shows how the 7 potential barriers were ranked as alternate choices by the respondents.

Table 2. Respiratory Care Practitioners' Responses Related to Perceived Educational Needs (n = 75)

Topic & Mean (SD) Response	1*	2	3	4
Patient History 1.987 (0.856)	31.6%	43.4%	19.7%	5.3%
Patient Interview 2.105 (0.842)	23.7%	48.7%	21.1%	6.6%
Chest Inspection 1.855 (0.875)	43.4%	30.3%	23.7%	2.6%
Breath Sounds 1.787 (0.859)	45.3%	34.7%	16.0%	4.0%
X-Ray Evaluation 2.720 (0.847)	8.0%	29.3%	45.3%	17.3%
Pulmonary Function 2.720 (0.994)	14.7%	22.7%	38.7%	24.0%
Arterial Blood Gases 1.408 (0.734)	71.1%	19.7%	6.6%	2.6%
Hematology 2.507 (0.891)	18.7%	20.0%	53.3%	8.0%
Sputum 2.067 (0.859)	29.3%	38.7%	28.0%	4.0%
EKG Evaluation 2.684 (0.941)	13.2%	25.0%	42.1%	19.7%
Pharmacology 2.513 (0.916)	14.5%	34.2%	36.8%	14.5%

*1 = no review or retraining needed; 2 = brief review needed; 3 = some retraining (minimum detail); 4 = extensive retraining needed (maximum detail).

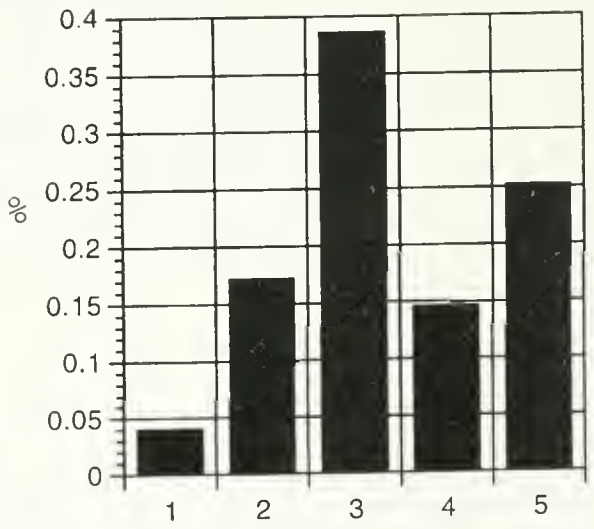

Fig. 3. Respiratory care practitioners' first choice of learning methods (n = 75).1 = independent study; 2 = lecture/question & answer; 3 = skill workshop/practice; 4 = simulations/case studies; 5 = clinical practicum/rounds.

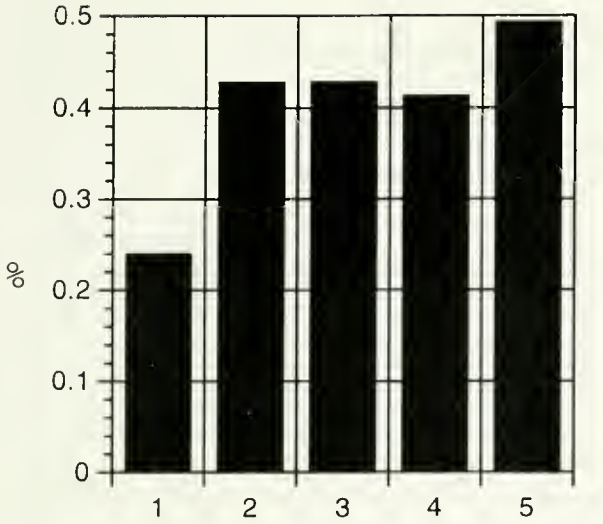

Fig. 4. Respiratory care practitioners' second choice of learning methods (n = 75).1 = independent study; 2 = lecture/question & answer; 3 = skill workshop/practice; 4 = simulations/case studies; 5 = clinical practicum/rounds.

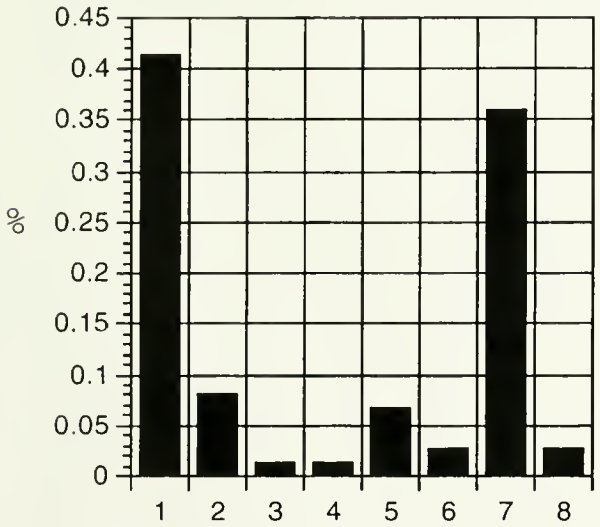

Fig. 5. The perceptions of respiratory care practitioners (RCPs) of the most important barrier to implementation of protocols in their hospital (n=75).1 = physician acceptance; 2 = nursing acceptance; 3 = RCP acceptance; 4 = administration acceptance; 5 = RCP review and retraining; 6 = heavy use of PRN/Pool RCPs; 7 = inadequate RC staff; 8 = other.

Table 3 demonstrates how RCPs believed that protocols would affect their role in the hospital. RCPs in 1 hospital accounted for the entire 9.7% who felt job security would decrease (31.8% of the RCPs responding from that hospital). Table 4 demonstrates the impact RCPs felt that protocols would have on respiratory care procedures (utilization, appropriateness, quality) and the respiratory care department (productivity, cost-effectiveness). Overall, utilization was

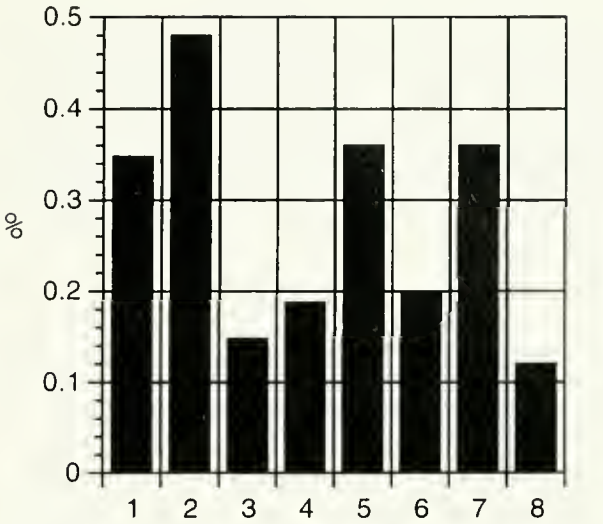

Fig. 6. The perceptions of respiratory care practitioners (RCPs) of alternative barriers to implementation of protocols in their hospital (n = 75); 1 = physician acceptance; 2 = nursing acceptance; 3 = RCP acceptance; 4 = administration acceptance; 5 = RCP review and retraining; 6 = heavy use of PRN/Pool RCPs; 7 = inadequate RC staff; 8 = other.

anticipated by 50% to decrease, however, at 2 of the 6 hospitals, 81.8% and 57.1% of the RCPs, respectively, anticipated that utilization would decrease. They accounted for a total of 83.3% of the RCPs who believed that utilization would decline. Of the 14.9% of RCPs who believed that productivity would decrease, 63.6% of them were employed at 1 hospital (31.8% of the RCPs responding from that hospital).

Table 3. Responses of Respiratory Care Practitioners Related to Perceived Effects of Protocol Implementation on Practitioner Roles

	Increased	Decreased	No Change
Responsibility (n = 75)	94.7%	1.3%	4.0%
Respect- recognition (n=75)	84.0%	0	16.0%
Job satisfaction (n=75)	85.3%	2.7%	12%
Job security (n=72)	59.7%	9.7%	30.6%

Table 4. Responses of Respiratory Care Practitioners Related to Perceived Effects of Protocol Implementation on Respiratory Care Procedures and Department

	Increased	Decreased	No Change
Utilization (n = 72)	40.3%	50.0%	9.7%
Appropriateness (n = 74)	94.6%	2.7%	2.7%
Quality (n = 74)	85.1%	2.7%	12.2%
Productivity (n = 74)	73.0%	14.9%	12.2%
Cost-Effectiveness (n = 74)	81.1%	10.8%	8.1%

Table 5 shows the rate at which the 4 statements that related to potential concerns of RCPs were selected. Of the 32% of RCPs who were concerned that the implementation of protocols was paving the way for nursing to assume responsibility for the delivery of respiratory care procedures, 58% were employed at 1 hospital (63.6% of the RCPs responding from that hospital). Of 73 responding RCPs, 97.3% supported the concept of respiratory care protocols.

Table 5. Points of Concern Expressed by Respiratory Care Practitioners Regarding Implementation of Protocols (n=75)

	Concerned	Not Concerned
RC education inadequate	16%	84%
Out of school too long	10.7%	89.3%
Job in jeopardy if not initially proficient	13.3%	86.7%
Assignment of RC to nursing	32.0%	68.0%

Discussion

It was encouraging to learn that more than half of the responding RCPs believed that they had at least a fair amount of knowledge of respiratory care protocols. The generally positive attitudes and opinions demonstrated by the results of the survey heightened the motivation of those RCPs involved in the implementation process. With 60% of the RCPs reporting that they had minimal or no clinical experience with protocols, the need for an extensive education program was brought sharply into focus. Looking at each hospital individually and as a part of the aggregate allowed identification of the difference in RCPs' opinion of their knowledge level and clinical experience across the 6 institutions.

Because approximately 75% of the responding RCPs indicated that they needed little or no review of patient history and interview techniques, and of chest inspection, some committee members questioned whether all responders fully understood the reliance on these skills given that they had not yet begun the orientation program. It was the opinion of 3 of the RCPs who facilitated the education program that the staff members in their hospital may have overestimated their knowledge of these subjects and, therefore, underestimated their need for review and retraining. The RCP facilitator in the fourth hospital disagreed. It was his opinion that the staff members in his hospital had accurately reflected their knowledge level on patient history and interview techniques and chest inspection. Coincidentally, all RCPs from this hospital reported having had at least a minimum amount of experience with protocols in the clinical setting. Because these RCPs had some experience, they should have been more aware of the skills needed. Their experience may have also increased their skill level above that of therapists without experience. In a study by Meredith et al,[13] respiratory care practitioners were requested to apply algorithms to 6 case studies. The results demonstrated a significantly higher correct response rate from staff members at hospitals using protocols than from staff at hospitals not using protocols.

The high level of concern that review and retraining would be inadequate prior to protocol implementation was not surprising in light of the number of RCPs with little or no clinical experience with protocols. The highest level of concern was reported in those hospitals that had the highest percentage of RCPs with no clinical experience. A second factor in the level of concern expressed may have been the timing of the survey prior to the beginning of the orientation program and before the RCPs were made aware of what retraining would be available. Recognition of the concern identified the need for a flexible education program. The program design allows the preceptors to adjust the number of patient assessments in Phase III to the individual needs of each RCP. (See Appendix 2 for an overview of the education program).

Even though skill workshops with practice sessions was the most preferred learning method, Phase I of the education program was designed around the videotape lecture series and self-directed case study practice. The advantage of this approach is that it addresses a wide spectrum of knowledge level and clinical experience. With the exception of the assessors trained to support the pilot program, RCPs can adjust the length of Phase I to meet their needs. With the lecture series on videotape, the presentations can be viewed and studied more than once if necessary. However in view of the low preference for independent study, the design of Phase I may lead less-motivated RCPs to delay Phase I and lose momentum. The RCP preceptors agree that the supervised patient assessment and care plan preparation (rounds) in Phase III, individualized to each RCPs needs, may be the key element in the education program. Clinical practicum/rounds with a preceptor was the second most preferred learning method among the responding RCPs. In addition, one hospital has added follow-up skill workshops and practice sessions to continue building the confidence of its staff members.

Physician acceptance has been reported in the literature as a potential barrier to protocol implementation.[3,8,14] Among the survey respondents, it was predicted to be the biggest barrier to implementation. Of the 4 hospitals who have implemented protocols, two report that physician acceptance has indeed been the biggest hurdle to overcome. One of these hospitals is a teaching institution, and it has been postulated that the residents may perceive the completion of the patient assessment and development of the care plan to be important to their learning process. The third hospital has not experienced the same degree of physician reluctance; however, the committee members approached the medical staff differently. They phased in protocols with one physician group at a time and did not move forward until they believed they had acceptance within that group. Currently they report that they have implemented protocols with approximately 50% of the medical staff. The fourth hospital does not perceive a problem with physician

acceptance. All four hospitals are reviewing strategies and putting plans into place to address the level of physician acceptance. Two hospitals have assigned full-time RCP physician liaisons and are having some early success with one-on-one physician contact. Three of the hospitals report that inadequate RC staffing has not materialized as a barrier, whereas the fourth hospital believes it has been and will continue to be a barrier. They continue to stress to their staff that protocols are a priority. Nursing resistance to respiratory protocols is not perceived as an important barrier in any of the four hospitals. We believe this to be a testimony to the orientation programs that were put in place and the open lines of communication between nursing and respiratory care.

Overall, the positive opinions and attitudes of the responding RCPs were impressive and very encouraging. The majority of RCPs anticipated an increased level of responsibility, respect, recognition, and job satisfaction. They also anticipated a positive impact on the appropriateness and quality of therapy, and the productivity and cost-effectiveness of the respiratory care department. The concerns expressed by RCPs regarding decreased utilization and productivity and declining job security, may be explained by their awareness of reengineering projects that were occurring concurrently with the respiratory care protocol project. The survey results highlighted the possibility that protocols were being perceived as a means for reducing the respiratory care staff to a core team of assessors and delegation of basic respiratory care procedures to the nursing staff. Recognizing this perception allowed it to be addressed before it became a serious barrier to implementation. At this writing (1997), no basic respiratory care procedures have been reassigned to nursing.

In Conclusion

The survey results guided the development of an education program that targeted the RCPs perceived educational needs and was flexible enough to address a wide range of knowledge and clinical experience. Although many RCPs believed that the impact of protocols on their role in the hospital and on the respiratory care department would be favorable, the survey effectively identified groups of RCPs who believed that protocols would decrease utilization, productivity, and job security and allowed their concerns to be addressed in the hospital-specific orientation program.

ACKNOWLEDGMENT

I thank Lynda Harkins PhD RRT for assistance with the statistical analysis and the Austin Area Respiratory Care Protocol Committee members for their support and cooperation: Richard Banning RRT, Ron Boultinghouse MBA RRT, Sandi Dunn RRT, Brenda Jones MBA RN RRT, Marlon McGough RRT, Joe McWilliams RRT, Bill Pickett RRT, Ron Purpora MS RPFT RRT, John Tierney RRT, Richard Welch RRT, and Robert Williams MA RRT.

REFERENCES

1. Meredith RL, Pilbeam SP, Stoller JK. Is our educational system adequately preparing respiratory care practitioners for therapist-driven protocols? (editorial). Respir Care 1994;39(7):709-711.
2. Kester L. Training staff in therapist-driven protocols. (conference report). Respir Care 1994;39(7):750.
3. Bunch D. Therapist-driven protocols: overcoming the obstacles. AARC Times 1993;17(Jan):47.
4. Fink J, Covington J. Primary patient care task force: a strategy to change utilization patterns, improve quality, and reduce costs outside of the critical care unit. (abstract). Respir Care 1992;37(11):1283.
5. Bunch D. TDPs and legal liability. AARC Times 1994;18 (Mar): 46,73.
6. Gilmore GD, Campbell MD, Becker BL. Needs assessment strategies for health care education and health promotion. Indianapolis: Benchmark Press Inc, 1989:27-28.
7. Des Jardins T. A model curriculum for the "assessment skills" essential for the successful implementation of "therapist-driven respiratory care protocols." In: Burton GG, Tietsort JA editors. Therapist driven respiratory care protocols: a practitioner's guide for criteria-based respiratory care. Los Angeles: Academy Medical System Inc, 1994:102-118.
8. Clifford CP. The respiratory care protocol: a physician's perspective. AARC Times 1991;15(May):61-62.
9. Stoller JK. Why therapist-driven protocols? a balanced view (editorial). Respir Care 1994;39(7):707-709.
10. Shrake KL, Scaggs JE, England KR, Henkle JQ, Eagleton LE. Benefits associated with a respiratory care assessment-treatment program: results of a pilot study. Respir Care 1994;39(7):715-724.
11. American Association for Respiratory Care. Therapist -driven protocols: the state of the art conference reports. Respir Care 1994;39(7): 746-756.
12. Tietsort J. The respiratory care protocol: a management tool for the '90s. AARC Times 1991; 15(May):55-56,58.
13. Meredith RL, Pilbeam SP, McCarthy K, Stoller JK. Proficiency among respiratory therapy educators, staff, and students in using algorithms for therapist-driven protocols. Respir Care 1996;41(7):595-600.
14. Shrake KL, Scaggs JE, England KR, Henkle JQ, Eagleton LF. A respiratory care assessment-treatment program: results of a retrospective study. Respir Care 1996;41(8):703-711.

APPENDIX 1
Respiratory Care Protocol Survey

1. Which statement below **best** describes your knowledge about Respiratory Care Protocols? **(check only one)**

   [ ] "I have no knowledge about RC Protocols."
   [ ] "I have minimal knowledge, mostly obtained from the discussions within our hospital."
   [ ] "I have a fair amount of knowledge obtained from hospital discussions, and/or reading professional journals."
   [ ] "I have a lot of knowledge on this subject from hospital discussions, reading, and/or clinical application."

2. Which statement below **best** describes your clinical experience with Respiratory Care Protocols? **(check only one)**

   [ ] "I have never used a protocol in the clinical setting."
   [ ] "I have a minimum amount of experience with protocols in the clinical setting."
   [ ] "I have experience in the clinical setting with **one or two** protocols only."
   [ ] "I have experience in the clinical setting with **six or more** RC protocols."

3. With implementation of RC protocols, RCPs will be conducting patient assessment which involves the following topic areas. Using the 1 - 4 scale, please indicate the amount of review or retraining **you feel you** need in each area.

   1 = No review/retraining needed
   2 = Brief review needed
   3 = Some retraining needed (minimum detail)
   4 = Extensive retraining needed (maximum detail)

	No Review	Brief Review	Min Detail	Max Detail
Patient History	1	2	3	4
Patient Interview	1	2	3	4
Chest Physical Assessment:				
–Inspection	1	2	3	4
–Breath Sounds	1	2	3	4
Chest X-Ray Evaluation	1	2	3	4
PFT Analysis	1	2	3	4
Laboratory Values:				
–ABGs	1	2	3	4
–Hematology	1	2	3	4
–Sputum	1	2	3	4
EKG Evaluation	1	2	3	4
Pharmacology	1	2	3	4

4. Protocols have an extreme reliance on evaluation and assessment skills. Are you concerned that you will receive inadequate review/retraining before the RC Protocols are implemented?

   [ ] YES [ ] NO

5. Which of the following learning methods do you **most** prefer? **(check only one)**

   [ ] Independent Study
   [ ] Lecture/Question-Answer
   [ ] Skill Workshop/Practice Sessions
   [ ] Simulations/Case Studies
   [ ] Clinical Practicum/Rounds with MD/RCP Preceptor

6. Which of the other learning methods do you like? **(check all that apply)**

   [ ] Independent Study
   [ ] Lecture/Question-Answer
   [ ] Skill Workshop/Practice Sessions
   [ ] Simulations/Case Studies
   [ ] Clinical Practicum/Rounds with MD/RCP Preceptor

7. What do you feel the **biggest** barrier to the implementation of RC Protocols will be in your respective hospital? **(check only one)**

   [ ] Physician acceptance
   [ ] Nursing acceptance
   [ ] RCP acceptance
   [ ] Administration acceptance
   [ ] RCP review/retraining
   [ ] Heavy use of PRN/Pool RCPs
   [ ] Inadequate RC staff
   [ ] Other (Please explain) _____

8. What other barriers to the implementation of protocols do you feel exist in your hospital? **(check all that apply)**

   [ ] Physician acceptance
   [ ] Nursing acceptance
   [ ] RCP acceptance
   [ ] Administration acceptance
   [ ] RCP review/retraining
   [ ] Heavy use of PRN/Pool RCPs
   [ ] Inadequate RC staff
   [ ] Other (Please explain) _____

9. How do you feel RC Protocols will affect the Respiratory Care Practitioner's role in your hospital? **(check one in each section)**

	Increase	Decrease	No Change
Responsibility	[ ]	[ ]	[ ]
Respect/Recognition	[ ]	[ ]	[ ]
Job Satisfaction	[ ]	[ ]	[ ]
Job Security	[ ]	[ ]	[ ]

10. How do you feel the implementation of RC Protocols in your hospital will affect each of the following? **(check one in each section)**

	Increase	Decrease	No Change
Utilization of RC Procedures	[ ]	[ ]	[ ]
Appropriateness of RC Procedures	[ ]	[ ]	[ ]
Quality of RC Procedures	[ ]	[ ]	[ ]
Productivity of RC Department	[ ]	[ ]	[ ]
Cost-Effectiveness of RC Procedures and Department	[ ]	[ ]	[ ]

11. Are any of the following points of concern to you personally? **(check all that apply)**

[ ] "I am concerned that my respiratory care education may be inadequate for the demands of RC protocols."
[ ] "I am concerned that I have been out of school too long to have adequate knowledge for the demands of RC protocols."
[ ] "I am concerned that if I can not initially demonstrate proficiency in patient assessment and protocol implementation that my job will be in jeopardy."
[ ] I am concerned that the implementation of RC protocols will pave the way for nursing to take over delivery of respiratory care procedures."

12. Do you support the concept of Respiratory Care Protocols?

[ ] YES [ ] NO

13. What other comments and/or suggestions do you have regarding Respiratory Care Protocols that may assist in the development of the orientation/training program and implementation of protocols in your respective hospital?

APPENDIX 2
Overview of Education Program

	Includes:
MATERIALS:	
–Videotape Lecture Series	Patient Interview Techniques Patient Assessment Techniques Bedside PFT Managing Patients with Asthma Managing Patient with Allergies
–Binder	Education Program Overview Pilot Project Overview ABC's of Protocols Assessment/Care Plan Form Six Approved Protocols Reference Material: –ABGs –Hematology –Blood Chemistry –Sputum Analysis –Patient History and Interview –Chest Physical Assessment –Bedside PFT and Analysis –Oxygen Therapy/Pulse Oximetry –Pharmacology Case Studies with Research Papers Practice Case Studies
–Pocket Guide	Six Protocols/Key Points Assessment/Care Plan Form Normal Lab Value Charts Respiratory Care Medication Reference Chart
EDUCATION PROGRAM:	
–Phase I	Video Lecture Series –Examination Practice with Case Studies
–Phase II	Five Case Studies –Assessment/Care Plan –Examination
–Phase III	Rounds with RCP Preceptor –Patient Assessment –Care Plan Preparation

Evaluation of the Health Occupations Aptitude Examination

Jeff Standridge MEd RRT NREMT-P, Kathy J Boggs MEd RRT, and Kathleen A Mugan MEd MT (ASCP)SH

INTRODUCTION: In our Respiratory Care Program, attrition rates vary, but periodically approach undesirable levels. To reduce attrition and more accurately predict success, a revision of the current selection procedures was necessary. We evaluated as one possible component of our admissions procedure, the Health Occupations Aptitude Examination (HOAE), an instrument, specifically for use by allied health education programs in admission, placement, and guidance procedures, that contains 5 separate tests. Scores are given for Academic Aptitude (A.A.), Spelling (Sp.), Reading Comprehension (R.C.), Information in the Natural Sciences (N.S.), and Vocational Adjustment Index (V.A.I.). EVALUATION METHOD: We reviewed the instrument's technical manual for norms, reliability-validity studies, and general test-development procedures. We then conducted a pilot study using a convenience sample of 49 respiratory care students from 3 different program years. To prevent respiratory care instruction from biasing the examination results, the HOAE was administered immediately upon admission to the Program, before any professional education commenced. Each test score from the HOAE was then correlated with professional respiratory care program grade point average (PrGPA) using the Pearson Product Moment correlation coefficient of 0.40 as a threshold and an α level of 0.05. RESULTS: Positive relationships were found between PrGPA and 3 of the 5 instrument tests. Statistically significant relationships were found between the A.A. Score ($r = 0.40$, $p < 0.05$), N.S. Score ($r = 0.40$, $p < 0.05$), and R.C. Score ($r = 0.31$, $p < 0.05$). CONCLUSIONS: The potential of the HOAE for strengthening our Program's selection process is not clear, although the V.A.I. provides useful information about specific behaviors and is useful in counseling. We will continue to administer the HOAE in order to determine its ultimate appropriateness as an admissions process component. [Respir Care 1997;42(9):868-872]

Background

Some allied health disciplines find it difficult to discover indicators of success in specific education programs. The Respiratory Care Program at our institution is no exception. Because of the variety of education experiences and the differences in grading scales, it has become difficult to predict program success in students, all of whom transfer to our institution from other postsecondary schools. Merely comparing college grade point averages (GPAs) is a potentially misleading solution. In addition, most applicants have GPAs between 3.0 and 4.0; this narrow range may not provide enough variability among accepted applicants to predict success.

Although the American College Test (ACT) composite score has been shown to correlate with success on the NCLEX-RN examination for associate degree nursing stu-

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dents,[1] the test was originally developed to predict the success of students going from high school to college. Applicants to the University of Arkansas for Medical Sciences Respiratory Care Program have completed at least 2 years of prerequisite coursework at another university. In addition, some have recently taken the ACT, while others have scores from 10 years ago and beyond. Occasionally, an applicant has not taken the ACT at all. Furthermore, ACT subscores in Social Science, Natural Science, Mathematics, and English have failed to provide substantial predictions for success in allied health programs.[1,2]

Noncognitive variables such as letters of reference or reference-rating forms provide little useful information. Our experience suggests that most students would not select an individual to provide a reference if they were not relatively certain of receiving a positive recommendation. In examining our own admissions criteria, no significant relationship has been found between these ratings and PrGPA ($r = 0.004$, $p > 0.05$).[3]

Although interviews are important in determining potential clinical success and affective attributes, the literature suggests that they are relatively ineffective in predicting academic success.[4-10]

Faced with this dilemma and rising attrition rates (Table 1), we sought to identify a reasonable addition to the student selection process that would be used in conjunction with college GPA and structured interview scores. The *Revised* PSB—Health Occupations Aptitude Examination (HOAE) was evaluated as one of those options. A number of health aptitude examinations exist. However, many are only available at certain times of the year and at specific testing centers. In addition, many of the available aptitude examinations are cost prohibitive as well. The HOAE is relatively inexpensive and easy to administer, making it a possible alternative to the more restrictive and costly aptitude examinations.

Table 1 Respiratory Care Program Enrollment and Attrition

Year	Enrolled	Graduated	Attrition Rate
1995	17	13	24%
1994	19	14	26%
1993	22	22	0%
1992	25	23	8%
1991	24	20	17%
Mean	21	18	14%

The Health Occupations Aptitude Examination

The revised HOAE was devised and developed by the staff of the Research and Development Division of the Psychological Services Bureau with consultant contributions. The original, or standard, version of the HOAE was published in 1978-1987; the revised version, in 1992.

The instrument was developed specifically for use by allied health occupations education programs.[11] The authors claim it is predictive, within reasonable limits, of readiness and suitability for specialized instruction in an allied health education program and is beneficial for other purposes such as counseling, curriculum planning, and remediation. The individual tests appear to sample a wide range of general, interlocked, and specific factors known to be important in the preparation of allied health practitioners.

The instrument is an individual assessment examination containing 5 separate tests. Scores are given in Academic Aptitude (A.A.), Spelling (Sp.), Reading Comprehension (R.C.), Information in the Natural Sciences (N.S.), and Vocational Adjustment Index (V.A.I.) (Fig. 1).

Part I— Test 1	Academic Aptitude	
	–Subtest 1	Verbal Concepts
	–Subtest 2	Arithmetic Concepts
	–Subtest 3	Nonverbal Concepts
Part II— Test 2	Spelling	
Part III— Test 3	Reading Comprehension	
Part IV— Test 4	Information in the Natural Sciences	
Part V— Test 5	Vocational Adjustment Index	

Fig. 1. Components of the Health Occupations Aptitude Examination.

Initial Impressions of the HOAE

The HOAE appears to be developed by well-regarded procedures and has been developed and normed specifically for the purpose of screening allied health education applicants. The publisher clearly describes the types of students on whom the norms are based and provides norms for each group to whom examinees are likely to be compared. There is an adequate description of how the individuals included in the norm group were sampled. However, participation rate and the date on which norms were established are not apparent.

For the most part, the evaluators and reviewers from the literature were satisfied with the HOAE and its published validity studies.[12,13] However, one reviewer did recommend that users of the test obtain a specimen set and examine the test based on their own program, applicant pool, and information needs.[13] To fully evaluate the HOAE and determine its appropriateness for addition to the selection criteria of our program, we conducted a pilot study.

Technical Review

Published literature reviewing the HOAE is scarce. After our literature search produced little useable information, we reviewed the instrument's technical manual[11] to evaluate the publisher's norming techniques and procedures for establishing validity and reliability.

Norms

The normative data for the HOAE are based on a sample of 3,960 applicants to allied health occupations education programs from 187 allied health programs in 49 states of the United States, 9 programs in Canada, and 2 programs in the District of Columbia. The 198 participating programs represented approximately 5.5% of the 3,600 programs located in the U.S. and Canada. The programs represented various types of institutions including secondary schools, vocational-technical schools, junior and community colleges, hospitals and medical centers, colleges and universities, medical schools, nonprofit (private or religious) organizations, academic health centers, and proprietary schools. In addition, they represented large and small programs, urban and rural areas, different cultural and socioeconomic settings, and differing ethnic and racial compositions.

The general norms are based upon applicants to these programs only. Prospective students were tested prior to admission into an allied health program, before test performance could be biased by learning experiences.

Appropriate information with regard to gender, chronologic age, and formal education is also included and categorized into 39 allied health specialties. Test results are reported to the user as raw scores, percentile scores, and on stanine scales. The standard error of measurement of the test and the standard error of the mean of the norms group are also reported and explained.

One potential concern is the studies conducted on the performance of minority groups after the initial standardization process was completed. These studies involved a group of African-Americans and Hispanics who were selected at random from the standardization population. However, there were 2 exceptions to their randomness. Race and ethnic background were identified and verified by a Program Director, and the minority groups and control groups had to be applicants to matching programs. Results of these studies were used to substantiate the claim that the general norms are based upon a heterogeneous group of applicants. This appears to be a somewhat backward process and may, in fact, constitute a problem.

Reliability

Reliability, or the consistency of measurement,[14] is especially important for Intelligence Quotients, aptitude, or vocational interest tests to be stable over time, or to have high test-retest reliability.[15] The HOAE did measure stability with test-retest reliability. A second test was given to 176 of the original examinees, 10 to 30 days after their initial tests. The authors of the HOAE believed that the length of the test precluded memorization of test items. In no subset of the battery did a significant gain demonstrate a practice effect. One of the reviews from the literature felt 176 was a rather small sample to retest.[12] We agree.

The reliability coefficients for test-retest were typically around 0.95. The attitude component was predictably the lowest at 0.88 and the coefficients for cognitive skills were 0.95 to 0.98. Because standardized tests should have reliability coefficients around 0.90,[15] we believe these to be acceptable.

Also analyzed was split-half internal reliability by comparing 105 of the examinees' even versus odd item responses. The even-odd forms of the test were administered in 7 testing periods over 12 days. This seems to us to be more nearly an alternate form of the same test rather than the split-half method as claimed by the authors. Split-half testing is described as an internal reliability method performed on one test, comparing the even to the odd responses.[15] The HOAE authors compared 2 separate forms using even versus odd responses and correlated the 2 scores using the Spearman-Brown formula. The coefficients of the subsets varied from 0.91 on the vocational index to 0.98 on academic aptitude with the mean coefficient being 0.96.

The intended use of the test is one of numerous factors to consider in evaluating an individual for admission to an academic program. As such, we felt that the reliability was sufficient.

Validity

Validity—or does the test accomplish the task for which it was intended?[14]—is the most important aspect of a test. It determines the inferences one can make about the behavior of the sample. Validity procedures determine whether the test scores can be compared to other independent observable facts about the behavior being considered.

Validity studies had been performed on the HOAE. Content validity, also called face or logical validity, refers to how well the questions relate to the content domain being tested and the specifications the author used to formulate the content.[11] This is done while the test is being constructed. The test authors established objectives and a table of specifications. The content was outlined using standard texts, literature, and reference sources. The expressed needs of allied health program directors were given high priority. Independent experts in allied health education programs reviewed all the material for relevance. Content experts wrote many more questions than were needed into a draft that was then examined by other content experts. The questions were selected based on curricula, textbooks, interviews with practitioners and faculty, and input from experts. After revisions, the questions were field tested. Each question had an item analysis performed, and poor questions were dropped or amended.

Criterion-related validity refers to the extent to which scores concur with or predict some given criterion. The authors stated that an objective of the test was to predict the success in course of study and work demands of the participants. The authors compared test performance to GPA obtained in the intended academic programs. Because the main test objective is to mea-

sure success in allied health academic programs, this seems like a reasonable, if not ideal, comparison.

Average correlations, using Pearson Product Moment coefficients (r), between cumulative grade point averages and scores on the HOAE varied from 0.32 for Sp. to 0.43 on the V.A.I. to 0.76 on the A.A. The subset mean was 0.52. As might be expected, A.A. and N.S. were highest with correlations of 0.76 and 0.60, respectively.

Pilot Study

We conducted a pilot study to examine performance on the HOAE as an indicator of success in our respiratory care program. Although many factors play a part in the ultimate success of Program graduates, one indicator is success on the National Board for Respiratory Care (NBRC) credentialing examinations. If graduates cannot pass the NBRC examinations, any other factors of success are relatively useless.

Successful completion of our professional Program is indicative of future success on the NBRC credentialing examinations (Table 2). However, admission into the Program is not necessarily indicative of successful completion, as indicated by the attrition rates listed in Table 1. While successful completion of the program suggests a fairly good chance of passing the NBRC credentialing examinations, faculty in our program believe it important to improve student selection, thereby reducing attrition and improving program efficiency.

Table 2 National 1995 Credentialing Examination Pass Rates and 5-Year Program Mean Pass Rates

Examination	Entry Level*	Written RRT	Clinical Simulation
National Pass Rate (1995)	86%	76.14%	60.9%
5-Year Program Pass Rate	99%	99%	97%

*Reported pass rate on the Entry Level Examination is for graduates of advanced practitioner (therapist-level) programs.

Methods

With this in mind, we chose to evaluate each section of the HOAE with regard to ending professional grade point average (PrGPA). A convenience sample of 49 respiratory care students was selected by taking all entering students from 3 consecutive program years. To prevent respiratory care instruction from biasing the examination results, the HOAE was administered immediately upon admission to the Program, before any professional education commenced. Upon graduation or attrition from the program, each separate test score of the HOAE instrument was correlated with PrGPA using the Pearson Product Moment correlation procedure.

Results

When one is seeking to relate academic achievement to predictor tests of achievement, such as the HOAE, a correlation coefficient of between 0.40 and 0.50 is considered satisfactory.[16] Using this range as a rule, significant relationships ($p < 0.05$) were found between PrGPA and 3 of the 5 instrument tests.

Pearson correlations coefficients are provided in Table 3. Although statistically significant beyond the 0.05 α level, the relationship between PrGPA and R.C. ($r = 0.31$) was relatively weak and by Popham and Sirotnik's criterion[16] unsatisfactory.

Table 3. Health Occupations Aptitude Examination Scores Related to Professional Grade Point Average (PrGPA)

	Correlation Coefficient for PrGPA*	p Value
Academic Aptitude	0.40	< 0.05
Spelling	0.13	> 0.05
Reading Comprehension	0.31	< 0.05
Information in the Natural Sciences	0.40	< 0.05
Vocational Adjustment	0.27	> 0.05

*Pearson Product Moment Correlation Coefficients between 0.40 and 0.50 are considered satisfactory.[16]

Discussion

Our pilot study produced somewhat lower predictive validity coefficients than those published in the technical manual. However, statistically significant relationships were found between PrGPA and 3 of the 5 instrument tests. Because the purpose of this study was to determine the suitability of the HOAE for addition to the current admission selection procedures, we found these correlations to be useful and the systematic evaluation helpful.

The results of this pilot study were consistent with the findings of Baker et al,[17] who found significant correlations between PrGPA and the A.A. test score and PrGPA ($r = 0.45$, $p < 0.01$), and the N.S. test score ($r = 0.44$, $p < 0.01$).

Limitations of This Evaluation

We do not believe that the results from this pilot study establish that the addition of the HOAE would be an adequate substitute for existing components. However, the data do provide useful information regarding the HOAE examination as a potential source of admission selection data. After using the HOAE for a number of admission cycles, we plan to investigate the predictive validity of the entire student selection system with regard to successful program completion, rate of attrition, and successful completion of the NBRC cre-

dentialing examinations. Future research, with a larger sample size would make the findings more generalizable. While caution should be used when trying to generalize these findings to other respiratory care programs, it appears that the HOAE is suitable for *addition* to selection systems that also utilize more traditional criteria for making admission decisions (ie, GPA, interview).

The instrument's usefulness as a counseling tool was evident to us. After review of the score reporting procedures, our opinion is that these reports seem to be suitable for counseling respiratory care students, upon admission to the program, regarding certain test scores relative to other respiratory care students in the norm sample, and future potential success in the respiratory care program. However, additional research is required to indicate the statistical validity of such opinions.

In Conclusion

We need to assess a student's affective behaviors prior to program admission. Structured interviews help with these qualities. However, we have found no adequate, additional means by which to measure these. The Vocational Adjustment Index provides some useful information about very specific behaviors pertinent to the professional aspects of respiratory care practice.

Based on our evaluation, the HOAE scores will be added to the admission criteria, making it an additional component in the formula used to select students. The revised admission criteria, with the addition of the HOAE are:

Qualities/Skills	Academic Criterion	HOAE Criterion
Academic	Cumulative Prerequisite GPA	A.A. Score
Problem-Solving	Math & Science GPA	N.S. Score
Communication	Speech & English GPA	R.C. & SP Score
Non-Academic	Interview Score	V.A.I.

Although our Pilot Study results were inconclusive, we have decided to continue using the HOAE as part of our admission requirements. By incorporating this, we hope to eventually study the results and efficacy of this admissions tool. On the basis of further study we may determine whether it should be eliminated or continued.

REFERENCES

1. Lengacher CA, Keller R. Academic predictors of success on the NCLEX-RN examination for associate degree nursing students. J Nurs Ed 1990;29(4):163-169.
2. Mills AC, Sampel ME, Pohlman VC, Becker AM. The odds for success on NCLEX-RN by nurse candidates from a four-year baccalaureate nursing program. J Nurs Ed 1992;31(9):403-408.
3. Standridge J. Correlating various admission variables with academic success in a respiratory care educational program (abstract). Respir Care 1997 (In Press).
4. Balogun JA. Predictors of academic and clinical performance in a baccalaureate physical therapy program. Phys Ther 1988;68(2): 238-242.
5. McGinnis ME. Admission predictors for pre-physical therapy majors. Phys Ther 1984;64(1):56-58.
6. Schmalz GM, Rahr RR, Allen RM. The use of preadmission data to predict levels of success in selected allied health students. Occup Ther J Res 1990;10(6):367-376.
7. Vargo JW, Madill HM, Davidson PR. The preadmission interview as a predictor of academic grades and fieldwork experience. Can J Occup Ther 1986;53(4):211-215.
8. Op't Holt TB, Dunlevy CL. The use of preadmission criteria to predict academic success in a 4-year respiratory care curriculum. Respir Care 1992;37(5):439-443.
9. Tompkins LS, Harkins CJ. Prediction academic success in a nontraditional program. J Allied Health 1990;19(1):15-24.
10. Posthuma B, Noh S. Interview scores and academic grades as selection criteria for admission to an occupational therapy program. Can J Occup Ther 1990;57(5):285-291.
11. Psychological Services Bureau. Technical manual: a report. Revised PSB-health occupations aptitude examination. St Thomas PA: Psychological Services Bureau, 1992.
12. Dunbar SB. Review of the PSB-health occupations aptitude examination. In: Kramer JJ, Conoley JC, editors. The eleventh mental measurements yearbook. The Buros Institute of Mental Measurements. Lincoln NE: The University of Nebraska Press; 1992:716-718.
13. Rudner LM. Review of the PSB-health occupations aptitude examination. In: Kramer JJ, Conoley JC, editors. The eleventh mental measurements yearbook. The Buros Institute of Mental Measurements. Lincoln NE: The University of Nebraska Press; 1992:718-719.
14. Wallen NE, Fraenkel JR. Educational research: a guide to the process. San Francisco: McGraw-Hill Inc, 1991; 85-100.
15. Oosterhoff A. Classroom applications of educational measurement, 2nd ed. Englewood Cliffs NJ: Macmillan Publishing Company; 1990:53-93.
16. Popham JW, Sirotnik KA. Understanding statistics in education. Itasca IL: Peacock Publishers Inc; 1992:71-75.
17. Baker J, Douphrate D, Ridley D. The use of the revised PSB-health occupations aptitude examination as a predictor of success in physical therapy students. J Phys Ther Ed 1996;10(2):63-67.

Utilizing Distance Learning To Provide Asthma Education to Adults and Children in Georgia

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Introduction

The health education needs of patients are often inadequately addressed by existing systems for health care delivery. Health education must be incorporated into current systems of health care delivery to shift from a model of disease treatment to a model of disease prevention, health promotion, and wellness. Individuals who live long distances from medical facilities usually have the greatest difficulty seeking and obtaining appropriate medical care and health education for treatment of acute illness or the management of chronic disease.

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In rural Georgia, the inadequacies or absence of effective health care and health education are severe, affecting many adults and children. About one half of Georgia's population is spread out over many miles in largely rural, farming communities. Out of 159 counties in Georgia, 59 have less than 10 physicians, and 8 have no physicians.[1] The allied health workforce, including respiratory therapists, is influenced by the number and type of physicians working in a community. It is shown that as the number of physicians in a community increases, then the range and quantity of allied health professionals also increase.[2] Today, telemedicine and distance education can provide greater access to health care and health education, especially for those who are living long distances from medical specialists. This paper describes the use of the Georgia Statewide Academic and Medical System (GSAMS) to provide asthma education via distance learning to adults and children living in rural Georgia.

Importance of Effective Asthma Management

According to the National Asthma Education Program Expert Panel (1991),[3] an estimated 10 million people in the United States have asthma. The Centers for Disease Control reports that the incidence, morbidity, and mortality of asthma have increased considerably during the past decade,

and children are at the greatest risk.[4,5] Despite greater understanding of asthma pathology, availability of specific asthma drugs and better methods for long-term management, recent studies cite increased prevalence in hospitalizations and mortality from asthma.[6-11] More than 5,000 people die annually from asthma.[12]

Asthma is the most common chronic respiratory illness of childhood affecting an estimated 4.8 million children.[5,13] Asthma can gravely affect quality of life because it is a major cause of activity limitation from any chronic illness in children. Approximately 10-12% of children seek medical attention due to the severity of their symptoms.[14,15] Consequently, asthma accounts for the majority of children's missed days from school or parents' lost wages from work due to respiratory illness. More than 10 million school days were missed due to asthma, which accounted for an estimated $900 million in lost wages for caregivers.[16] Studies have shown that children with asthma have an increased risk for learning disabilities as compared to other children.[17] It has also been shown that asthmatic children with lower socioeconomic status appear to be at greater risk for school absence and grade failure.[17]

Effective management of asthma is based on 4 essential components: objective measures of lung function, comprehensive pharmacologic therapy, environmental control measures to reduce allergens, and patient education.[3,12] It is our opinion that too often, we focus on pharmacologic interventions and fail to adequately address the specific questions, misconceptions, and concerns of our patients. It is critical that adequate asthma education is provided to address the issues of (1) increasing morbidity and mortality, (2) rising direct costs for medical care, (3) substantial indirect costs associated with missed school and work, and (4) adverse effects on quality of life for children and caregivers. It is estimated that the total economic costs for asthma in 1990 were $6.2 billion when including the health care expenditures, mortality, lost school days, and missed days from work.[16]

The education component of asthma management cannot be overemphasized for the effective control of this chronic disease and the costs associated with its management.[18] Several studies have documented how asthma education can improve patient management and possibly decrease the health care costs.[19-21] We believe that utilizing distance education can facilitate implementation of the *Expert Panel Report I (EPR-I) and II (EPR-II): Guidelines for the Diagnosis and Management of Asthma* regarding health education for persons who have asthma and their caregivers.[3,12] Consequently, we obtained a grant through the Department of Administrative Services, Georgia Statewide Academic Medicine System to utilize distance learning to provide asthma education to school teachers, children and their caregivers. With support from the grant and the Medical College of Georgia, the faculty, volunteers, and paid staff were able to provide 6 asthma education programs at 18 sites throughout the state of Georgia (Figs. 1 and 2).

Fig. 1. *Make a Healthy Home for Children with Asthma*, Georgia Statewide Academic and Medical Systems sites. ● = distance learning locations; ▲ = telemedicine locations.

Fig. 2. *Breathin EZ*, Georgia Statewide Academic and Medical System sites. ● = distance learning locations; ▲ = telemedicine locations.

Distance Education

Distance education (also referred to as distance learning) has been defined as "formal instruction in which a majority of the teaching function occurs while educator and learner are at a distance from one another."[22] It typically involves the use of some type of education media to transfer the course content between instructor and learner. The concept of distance education has evolved as a way of bridging the physical distance between instructional resources and expertise and learners who, for a variety of reasons, lack access to these resources.

Originating as an outgrowth of correspondence courses delivered by a postal system, distance education has garnered worldwide acceptance extending educational opportunities across state and international boundaries. The dramatic pace of technologic innovation in telecommunications has supported a proliferation of educational delivery solutions, eg, satellite, terrestrial microwave, cable television, compressed video, and the Internet. Many medical institutions have now reached a point where they are successfully integrating telemedicine/distance education systems into their everyday operations for delivery of medical care and professional education in pulmonary medicine, allergy/immunology, and respiratory care.[23]

The Georgia Statewide Academic and Medical System

The GSAMS "is the largest interactive distance education network in the world."[24] The interactive distance education and telemedicine networks were established as a result of funding provided by the Distance Education and Telemedicine Act of 1992 (Senate Bill 144).[25] The Georgia Department of Administrative Services administers and manages the network's technical operations. The Academic Programming Office was established to serve as a resource for the dissemination of information and the promotion of GSAMS programs. The Academic Programming Office also offers grants to support distance programming, a weekly newsletter, a World Wide Web site promoting the network, and a computer listserv for discussion and announcements. One can access the GSAMS home page via <http://www.gactr.uga.edu/GSAMS/GSAMS.html>; the home page links to numerous areas of interest including *GSAMS Newsletter* and instructional materials.

The GSAMS network comprises more than 360 distance education classrooms and a total of 59 projected telemedicine clinic sites located throughout the state of Georgia. GSAMS classrooms are located in Georgia colleges and universities, technical institutes, K-12 schools, correctional facilities, some hospitals, administrative offices, and other special sites including Zoo Atlanta, The University of Georgia Marine Extension Service, Fernbank Science Center, and the Georgia Public Television studios in Atlanta. Each site operates in an autonomous manner, determining the type and frequency of programming it originates and receives, the amount of technical support it provides, and fees it charges. Site fees range from no fee at all to $100/hour with most sites averaging a charge of $25/hour including technical facilitation. Each GSAMS site pays a basic fee for a total of 62.5 hours/month of use.

These two-way interactive compressed video sites utilize T-1 communication lines to transmit both audio and video, enabling students and instructors at separate locations to see, hear, and speak with each other. The heart of the classroom system is the coder-decoder (CODEC). The CODEC's main function is the digitization and compression of analog audio and video signals that are sent out and received by the different sites.[25] A standard GSAMS classroom is equipped with main and auxiliary cameras, television monitors, microphones, telephone/facsimile machine, videocassette recorder—or VCR, document camera, and touch control panels. The document camera can project 2- and 3-dimensional images from photographs, slides, objects, and text, allowing zoom or close up views of the item on the viewer. Peripherals such as a video pointer, computer, or video-slide projector can be added to enhance the system.

The Medical College of Georgia supports 4 GSAMS distance education classrooms on its campus. The Institution currently delivers 5 complete academic credit programs in allied health by distance instruction, allowing students to earn professional degrees from the Medical College of Georgia, with little or no time spent on campus. Some of the satellite programs involve clinical faculty at the distant site and increased utilization of computers, and the Internet, in addition to the classes conducted via GSAMS. It is suggested that training sites in rural communities can prepare allied health students for rural practice, enhance access to care in underserved communities, and provide career opportunities for rural residents.[26] A major objective of distance education in allied health at our Institution is to achieve a broader distribution of allied health practitioners throughout the State by enabling students to earn professional degrees while remaining in their local communities. Additionally, we provide distance outreach programs including continuing medical and professional education programs and other health awareness/disease prevention programs for patients, children, and parents. We also utilize GSAMS to receive undergraduate and graduate courses for academic credit and courses for continuing education.

Preparing Materials & Conducting Programs

When conducting an outreach program via distance education, several important practical considerations should be taken into account. The distance-teaching environment differs from that of the traditional classroom. This provides instructors both new opportunities and challenges. Distance instructors often need to adopt different instructional roles, teaching skills, and strategies. Additionally, the faculty must become comfortable in the distance-teaching environment and familiar with available instructional support tools. The effective-

ness of distance teaching is integrally related to how well an instructor can use the technology, understand its potential and limitations, and his or her familiarity with associated instructional methods.[27]

In a conventional teaching environment, most instructors depend upon the body language and facial expressions of his or her students as a simple classroom assessment tool. Using this method, it is relatively easy to determine if students are bored, puzzled, or engaged in the material. In an interactive television environment, it is often difficult to see or to assess the body language of individual students. Therefore, instructors must consciously plan for interaction and feedback.[28,29]

When developing instructional materials to be used with interactive television, it is important to understand that television is a horizontal format. Any presentation graphics displayed on the system should be designed in a landscape orientation. Font sizes, number of lines of text per graphic, and color combinations must be carefully considered and these considerations can differ markedly from live presentations. Figure 3 offers our suggestions for preparing slides for interactive television and an example of a slide from our program. Handouts and other instructional support materials should be sent to the remote sites in advance of the program. Handouts are usually welcomed by program participants, provide space for note taking, and serve as a discussion tool.

For most of us, our typical experience with the television environment is that of a passive receiver. Our interaction with televised programming is limited to using the remote control. The interactive television environment not only enables interactions between learners and content, but learner-instructor and learner-learner interactions.[30] In a distance education environment, the instructor is primarily responsible for creating effective interaction in the classroom.[31] His or her actions and behaviors work toward bridging the physical and psychological distance between on-site and remote site classrooms.

The instructor often adopts the role of facilitator, planning for student interactions and engagement by creating a mix of information content and student interaction. Instructors can additionally employ effective on-camera behaviors such as maintaining eye contact with remote site students; refraining from wearing busy, distracting clothing or shiny, reflective jewelry; and, becoming aware of distracting movements such as pacing.

Our Asthma Education Programs

Our project took a multidisciplinary approach involving the Project Director, Coordinator of Distance Education, and faculty from medicine and allied health sciences. Each member of the team offered a valuable perspective and contributed specific expertise. For example, the coordinator of distance education handled the marketing and program arrangements; the project director obtained human assurance approval and coordinated data collection; the health information management (HIM) faculty developed one of the Microsoft Powerpoint presentations; and the physician, HIM faculty, and respiratory

A

Suggestions for Preparing Slides

Presentation Template	Choose a simple presentation template like banners; avoid patterns, lines, textures, prints.
Font Selection	Use a bold, sharp font like Arial Rounded MT Bold.
Font Size	Choose the largest font possible. Recommend 54 points for title, 48 points for headings, and 44 points for text.
Font Shadow	Use slight shadow to lift text from page. Recommend black shadow, down 2 points and to the right 3 points.
Layout of Text	Use minimal words and lines. Recommend main heading and only 3-4 lines of text, leave bottom right corner blank to allow the camera operator to insert video of the presenter.
Slide Colors	Choose soft, pastel colors with moderate contrast. Recommend a soft blue/green (teal, jade) for background, beige/peach for fillers, black color font headings and shadows, grey color for text.
Slide Uniformity	Prepare slides that are uniform in all of these characteristics to facilitate technical support and a professional presentation.

B

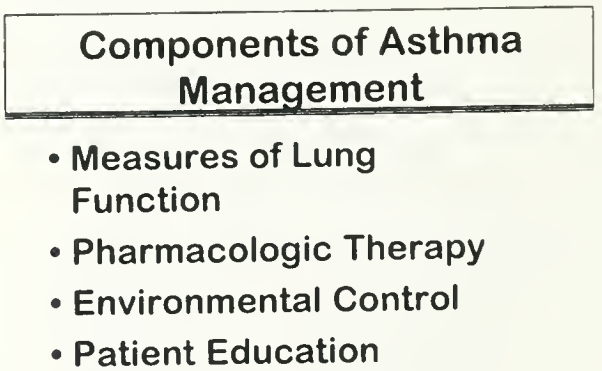

Fig. 3 A. Suggestions for preparing slide presentations for distance education via interactive television. B. This sample slide from our program was prepared with Microsoft Powerpoint and is reduced 40%.

therapy faculty/staff did the teaching. Together, we determined our program content and the content validity of all of our materials, including survey instruments.

The GSAMS grant provided a modest amount of funding for personnel costs such as program faculty. However, the coordinator of distance education, the technical support staff, faculty, and other staff incorporated this project within their existing duties and responsibilities and were not paid additional monies for participation. The GSAMS coordinators and school teachers volunteered to handle all arrangements at each remote site prior to and during each program. We did not charge a registration fee for enrollment in our asthma programs.

Development

We developed 2 asthma education programs for distance education. Our programs were designed to emphasize the essential components of effective asthma management.[3,12] One program, *Breathin' EZ*, was specifically designed for children, and another program, *Make a Healthy Home for Children with Asthma*, was designed for adults with asthma and caregivers. The content for the *Breathin' EZ* program was developed for elementary school children in grades 3-5 to fit their school curriculum, including objectives for Healthy People 2000.[32] The 1-hour children's program focused on normal pulmonary physiology and the changes that happen with asthma. A major goal of the program was for children to understand the normal defense mechanisms of the lung, and then the ways children with asthma can stay healthy. A related goal was for children with asthma to feel 'OK' about themselves and for their classmates to understand how and why they use medications to avoid attacks. Another goal was for school teachers and administrators to have increased knowledge on the ways children with asthma can avoid attacks and the role of medications in self-management. The goals of our adult program were to inform caregivers, including parents and teachers, of specific environmental control measures to reduce allergens and improve long-term management of asthma.

Marketing Our Programs

Georgia is a predominantly a rural state having many local activities, such as sporting events, meetings, and other community functions, taking place at the school site. For this reason, we determined that an effective way to reach school teachers, caregivers, and children with asthma would be through the school system. Also, many of the local GSAMS sites are placed in the local school or hospital for that particular community.

The programs were advertised on-line via the GSAMS World Wide Web site and a computer listserv delivered to most GSAMS coordinators, school technology support personnel, and media specialists. One can find a copy of our advertisement on the GSAMS Web site. We also placed advertisements in the weekly *GSAMS Newsletter*. The advertisement indicated that a voluntary pre- and post-test would be administered to those attending the programs for adults (Appendix). Interested schools were asked to reply by facsimile, telephone, or e-mail. Program dates were set based on these replies. Once the dates were set, the program advertisement was updated and re-posted to attract additional sites.

Twelve schools inquired about participating in *Make a Healthy Home for Children with Asthma*; and 8 inquired about *Breathin' EZ*. Program scheduling was arranged based on these inquiries. Dates were set for each program to be offered once/month for 3 months during February, March and April of this year (1997). *Make a Healthy Home for Children with Asthma* was offered in the evening from 7-9 PM. *Breathin' EZ* was offered during the school day at a convenient time for teachers. Each school was sent promotional fliers to be distributed to students to take home to their parents. A local facilitator agreed to provide information about the program and to be available at each site. We had 129 children, 12 teachers, and several parents attend the *Breathin' EZ* programs, and 55 adults participate in the *Make a Healthy Home for Children with Asthma* Programs.

Implementation & Evaluation

We attempted to make each of the programs as interesting and interactive as possible. For the children's program, the 2 facilitators decided to begin with the "cilia wave." The children were given a brief description of cilia and their role in the lung. Then, the children were asked to pretend that they were cilia and to raise their arms and hands over their heads. The children were told to move their hands all the way up and forward (representing the power stroke) and then move their hands all the way backward (representing the return stroke). The facilitators demonstrated the "cilia wave" while they checked in with each site to see the children laughing and participating, pretending they were cilia. The facilitators used this icebreaker and lead-in to a discussion of the normal defense mechanisms of the lung, asking the children questions throughout the program. The children were also encouraged to ask questions throughout the program. At the conclusion of the program, the children were asked again to wave good-bye and do the "cilia wave."

A brochure from the American Lung Association (ALA), *As You Live You Breathe*,[33] was used to assist in the development of the *Breathin' EZ* programs. Core information from the brochure regarding normal lung physiology and defense mechanisms of the lung were incorporated. Each child was given the ALA brochure after the program to reinforce concepts. A variety of instruction aids were incorporated into the presentations including photographs, slides, models, drawings, and graphs. A major advantage to distance education is the use of a document camera which allows clear projection of documents and three-dimensional objects. It is pos-

sible to use various colored pens to illustrate a point on a document and everyone in the class is able to see it clearly. For example, during the *Breathin' EZ* program, the facilitators used different colored pens to illustrate the upper airway from the lower airway and the conducting airways from the gas exchange airways/units.

The *Make a Healthy Home* program was designed primarily to educate adults on numerous strategies that they could use to decrease exposure to indoor and outdoor allergens. The national asthma guidelines clearly state that environmental control strategies to reduce exposure to allergens should be part of long-term asthma management.[3,12] However, we find that many of our patients are generally unaware of the changes that they can make in their homes to reduce exposure to allergens and improve long-term management of asthma. Therefore, we decided to meet two of the EPR Guidelines by focusing on patient education and environmental control strategies.[3,12]

For the adult programs, we incorporated research objectives; therefore, we obtained informed consent and administered a pretest at each site prior to the programming. We were required to have full review from our Internal Review Board (IRB) for Human Assurance. To obtain IRB approval, we determined that the principal investigator would explain the consent form and research project 'on-line' and then identify persons obtaining informed consent at each remote site. The participants, principal investigator, and investigator obtaining consent signed each form. After obtaining informed consent, we administered a pretest as shown in the Appendix. Following the program, each participant took an identical exam as the post-test. We are in the process of performing a follow-up questionnaire and analyzing our data to determine whether our programs increased participants' knowledge of environmental control strategies in the long-term management of asthma and whether participants actually made changes in their homes to implement environmental control strategies.

The adult program was scheduled for almost 3 hours to allow for preregistration, informed consent, programming, a question-and-answer period, and post-test. Actual programming time when we were 'on-line' was 2 hours. During our program, the participants learned how reduced humidity can decrease the amount of mold and dust mite allergens in the home. They also learned strategies for decreasing pet dander, cockroach and dust mite allergens and ways to minimize exposure to irritants such as cigarette smoke, aerosols, fumes, and other chemicals.

The last 30 minutes of each program was devoted to questions and answers. During this part of the program, we were surprised to find that some of our audience were using room and whole-house humidification systems as part of their long-term management. Because Georgia has a warm and moist climate except for the winter months, humidification is not indicated; and, instead, dehumidifiers may be recommended. We had many questions about where to purchase mattress and pillow coverings and how to clean bedding. We also had questions about when to test for allergies, the proper use of metered dose inhalers, and asthma pharmacology. We also had several questions about special types of vacuum cleaners and where to find high-efficiency particulant air (HEPA) filters. As requested by several parents, we forwarded materials about where to obtain or purchase the products that we mentioned in our talks.

Limitations & Special Considerations

Several factors contributed to the limitations of this project. The first limitation involved program scheduling. Participants of these programs were identified with the assistance of the co-sponsoring public school or other educational institution. Scheduling conflicts arose because the GSAMS network offers communities the opportunity to receive programs from other institutions within the GSAMS network. The delivery dates of the asthma education programs had to be flexible in order to coordinate the scheduling of multiple sites. In one case, the evening program for adults and caregivers was rescheduled for another evening to avoid conflicting with a course being offered for college credit.

A second limitation was the weather. Severe thunderstorms occurred on all 3 evenings when the *Make a Healthy Home for Children with Asthma* program was offered. We actually lost 1 site during part of the programming because of the weather and 1 site had no participants because they had tornado warnings and severe storms. The inclement weather probably impacted the attendance at these programs.

The third limitation was the size of the classrooms. Planning for the programs included consideration of classroom capacity. GSAMS classrooms range in size from small rooms comfortably seating 10-15 attendees to large classrooms seating an excess of 100 people. In one case, we actually had participants standing in the back of the room because of the large audience. When marketing any community outreach program, it is important to try to coordinate the anticipated class size with the seating arrangements and facilities. Alternate plans should be in place to accommodate additional seating whenever possible while remaining within building-fire codes. Because we did not charge a fee for attendance at any program, it was more difficult to project class sizes.

A fourth limitation involved communications with the local coordinators. In one instance, 4 teachers and the facilitators were present, but no participants showed up making them realize that the program fliers gave a different date. We resolved this problem by rescheduling that particular site. In another instance, we had high school students participate even though the *Breathin' EZ* program was advertised for elementary school children. The facilitators quickly adapted to incorporate the high school students into the teaching and discussions. The high school students were able to apply their knowledge to teach the younger students. At one site for the *Breathin' EZ* program, we had 49 children with asthma and their parents

in the audience, even though the program was marketed for all children. When changes or special circumstances occur, it is important that the distance education coordinators and facilitators accommodate these special needs and modify the program content and delivery whenever possible.

Conclusions & Recommendations

Distance education provides a unique opportunity to meet patient education needs and to focus on health promotion. We describe how we utilized our statewide system for distance education to provide multidisciplinary asthma education programs via interactive television. Distance education is ideal for reaching rural towns and villages who do not have medical specialists in their communities. Distance education provides a tool for focusing on disease prevention and health promotion through interactive educational programs for children, teachers, and caregivers. We propose that respiratory therapists should explore avenues for meeting patient education needs by incorporating multidisciplinary approaches and utilizing distance education.

REFERENCES

1. Randolph L, Seidman B, Pasko T. Physician characteristics and distribution in the US. Chicago: American Medical Association; 1997.
2. Morris LV. Education and the workplace: Georgia's health professions in the 1990s. Athens GA: The University of Georgia Institute of Higher Education; 1992.
3. Guidelines for the diagnosis and management of asthma. Expert panel report. National Asthma Education Program. Bethesda MD: National Heart, Lung, and Blood Institute of Health, Publication No: 91-3642; 1991.
4. Centers for Disease Control. Asthma—United States, 1980-1987. MMWR 1990; 39:493-497.
5. Centers for Disease Control and Prevention. Asthma—United States, 1989-1992. MMWR 1995;43:952-955.
6. Evans R, Mullally DI, Wilson RW, Gergen PJ, Rosenberg HM, Grauman JS, et al. National trends in the morbidity and mortality of asthma in the US: prevalence, hospitalization, and death from asthma over two decades: 1965-1984. Chest 1987; 91:65S-74S.
7. Centers for disease Control and Prevention. Asthma mortality and hospitalization among children and young adults-United States, 1980-1993. JAMA 1996;275(20):1535-1537.
8. Gergen PJ, Weiss KB. Changing patterns of asthma hospitalization among children: 1979 to 1987. JAMA 1990; 264:1688-1692.
9. Schenker MB, Gold EB, Lopez RL, Beaumont JJ. Asthma mortality in California, 1960-1989: demographic patterns and occupational associations. Am Rev Respir Dis 1993; 147:1454-1460.
10. Sly RM. Increases in deaths from asthma. Ann Allergy 1984; 53:20-25.
11. Weiss KB, Wagener DK. Changing patterns of asthma mortality. Identifying target populations at high risk. JAMA 1990; 264:1683-1687.
12. Expert panel report II: Guidelines for the diagnosis and management of asthma. National Asthma Education and Prevention Program; 1997.
13. Adams PF, Marano MA. Current estimates from the National Health Interview Survey, 1994. Vital Health Stat 1995; 10:94.
14. Lee DA, Winslow NR, Speight ANP, Hey EN. Prevalence and spectrum of asthma in childhood. Br Med J 1983; 286:1256-1258.
15. Gergen PH, Mullaly DJ, Evans R. National survey of prevalence of asthma among children in the United States, 1976 to 1980. Pediatrics 1988;81:1-7.
16. Weiss KB, Gergen PJ, Hodgson TA. An economic evaluation of asthma in the United States. N Engl J Med 1992; 326: 862-866.
17. Fowler MG, Davenport MG, Garg R. School functioning of US children with asthma. Pediatrics 1992;90(6):939-944.
18. Walton JR. Understanding the cost of health care with specific attention to respiratory care. Respire Care 1997; 42(1): 54-70.
19. Wilson SR, Scamagas P, German DF, Hughes GW, Lulla S, Coss S, Chardon L. A controlled trial of two forms of self-management education for adults with asthma. Am J Med 1993;94(6):564-676.
20. McFadden ER Jr, Elsandi N, Dison L, Takacs M, Deal EC, Boyd KK et al. Protocol therapy for acute asthma: therapeutic benefits and cost-savings. Am J Med 1995;99(6):651-661.
21. Lawrence G. Asthma self-management programs can reduce the need for hospital-based asthma care. Respir Care 1995;40(1):39-43.
22. Verduin JR, Clark TA. Distance education: the foundations of effective practice. San Francisco: Jossey-Bass; 1991. p. 13.
23. Daus C. Long-distance healing: telemedicine links outlying patients with asthma clinics and pulmonologists. RT 1997; 10(2):73-75.
24. Walsh J, Reese, B. Distance learning's growing reach. T.H.E. Journal 1995;22(11):59.
25. Minoli D. Distance learning technology and applications. Norwood MA: Artech House; 1996.
26. Gupta GC, Konrad TR. Allied health education and rural health professional shortage areas in the United States. JAMA 1992; 268: 1127-1130.
27. Moore MG, Kearsley G. Distance education: a systems view. Belmont CA: Wadsworth Publishing Inc; 1996.
28. Willis B. Strategies for teaching at a distance. ERIC Document Reproduction Service No. ED 351 008; 1992.
29. Oliver EL. Video tools for distance education. In: Willis B, editor. Distance education strategies and tools. Englewood Cliffs NJ: Educational Technology Publications; 1994.
30. Moore MG. Three types of interaction. Am J Distance Educ 1989; 3(2):1-6.
31. Winn B. Media and instructional methods. In: Garrison DR, Shale D, editors. Education at a distance: from issues to practice. Malabar FL: Robert E Krieger Publishing Company; 1990.
32. Healthy People 2000: National Health Promotion and Disease Prevention Objectives. Public Health Service Publication No. 91-50213, Washington DC: Department of Health and Human Services; 1990.
33. As you live you breathe. New York: American Lung Association, Pub. No. 0061-8/91.

APPENDIX
Control of Allergens Questionnaire (CAQ)

Your name: _____

Address: _____

Phone: _____

1. Allergy should be considered in the diagnosis of asthma because:
   a. many patients with asthma also have allergies
   b. if you have allergies you cannot have asthma
   c. allergy and asthma are the same thing
   d. treating asthma can make allergies worse

2. Which of the following is an indoor allergen:
   a. ragweed
   b. pollen
   c. dust mites
   d. grasses

3. Which of the following is an outdoor allergen?
   a. animal dander
   b. cockroach
   c. dust mites
   d. ragweed

4. Which of the following is NOT an allergen or irritant?
   a. cigarette smoke
   b. sugar
   c. cat dander
   d. dust mites

5. Which of the following could help some people who have asthma?
   a. getting a cat for a pet
   b. using pest control for roaches
   c. using a humidifier
   d. keeping the pet indoors

6. What changes in the child's bedroom can help manage asthma?
   a. keep stuffed toys on the bed instead of the floor
   b. use carpeting instead of bare floors
   c. wash bedding once a week in hot water
   d. keep the room hot and moist

7. Which of the following is NOT part of asthma management?
   a. control allergens and irritants
   b. provide patient education
   c. measure lung function
   d. use a high fat diet

8. Which of the following can make a healthy home for children with asthma?
   a. eliminate smoke from cigarettes, stoves and fireplaces
   b. wash sheets in cold water every month
   c. keep windows open for fresh air
   d. groom pets regularly

Part II Directions:
Write answers to these questions. Use the back if more space is needed.

1. What are the three main symptoms of asthma?

2. List the indoor allergens and irritants. Name as many as possible.

3. Write down the ways that you can reduce allergens in the home. List as many as possible.

Follow-up Questions to the CAQ

Your name: _____

1. Have you done anything to reduce asthma allergens and irritants in your home? Yes or No

2. If no, why didn't you make any changes? If yes, what changes have you made?

3. Have you noticed improvements in asthma since you made changes in your home? Yes or No

4. If yes, describe who has asthma and what improvements you notice.

5. What is your biggest problem when you try to reduce allergens in your home?

The Evolution of Clinical Simulations in Respiratory Care

Randy De Kler MS RRT

Introduction
Pedagogy of Simulations
  Characteristics
  Format
  Use
History of Clinical Simulations
Where Are We Today?
Where Will We Want to Go Tomorrow?

Introduction

Simulations are not new to education or training. Artificial or simulated representations of reality have been common for some time. The National Board of Medical Examiners (NBME) began using written simulations to assess physician competency in 1961.[1] The National Board for Respiratory Care (NBRC) replaced an oral examination format with a written clinical simulation format in 1979.[2] Both the quantity and quality of simulations has increased over the years, as has the evidence to support their effectiveness.[3] When used appropriately, simulations can be powerful learning tools that allow users to experience lifelike situations that would be too costly, too time consuming, or too risky to introduce into the educational experience.[4,5] The adaptability of simulations to specific needs and interests can provide great motivation for both instructors and students. Additionally, health care simulations may allow for skill and knowledge assessment. Simulations, in one form or another, have been a part of the respiratory care education and credentialing process for more than 20 years.[2,6]

The Pedagogy of Simulations

Characteristics

A simulation is an activity in which learners are assigned specific roles and/or goals for assessing, interpreting, and resolving imitated, real-life events, processes, or conditions. Learners function, for a time, within the constraint of this artificial representation of reality. Simulations are of value because they provide practice for learners, safety for potential patients, and control for instructors.

One of the most engaging characteristics of simulations is that they require active participation by the learner and often involve decision making.[7] Yet this characteristic presents a problem for many students. In the United States, as in other countries, the education system has traditionally been somewhat passive in its delivery system.[8] In this type of system, the teacher alone imparts knowledge, and the learner is expected to absorb it. Frequently, the student has no active part in the learning process. This method of instruction may not always be effective. Meaningful learning is more likely to occur if the learners are actively involved in the process. Learners sometimes have difficulty with simulations and other active learning activities, when confronted with them for the first time, because they have little or no experience in this type of learning environment.[9] This requires respiratory care educators to institute active learning activities early in their programs so that learners can begin their adjustment to these activities as soon as possible. This may allow these learners to benefit from active learning activities throughout their education experience.

Another characteristic of simulations is that they usually reduce the physical and emotional risks of a real-life situation.[10] For example, the emotional risks of making an inappropriate wellness choice are much less significant in a simulation activity than in real-life. A teenage girl can "experience" the consequences of choosing to smoke while pregnant; the health effects on her "baby" may be seen without actually producing a negative outcome. Cardiopulmonary resuscitation (CPR) skills are learned in a safer way when performed on a mannequin—a simulated situation. Mistakes can be made,

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corrected, and learned from without causing harm to a real patient. In clinical simulations, patient management choices that result in catastrophic consequences for the simulated patient are only learning experiences and do not actually harm a real person.[11-13]

Simulations allow instructors to control the sequence and the situation in which learners experience concepts.[12] In a simulation of mechanical ventilation management, the instructor may decide the timing of certain events and crises, including the determination of initial ventilator settings or the development of acute lung injury. The situations the learner encounters may also be controlled in number and complexity.[14] A simulation may be designed for learners to encounter relatively minor problems before they are presented with those that are more critical or require greater skill or experience to solve.[15] Conversely, a simulation can present the learner with a critical situation as soon as it starts.[16] This control allows an array of clinical possibilities that can be tailored to a specific set of instructional objectives.[17-19]

Time can be condensed or expanded in a simulation.[20] Clinical activities that may take weeks in real life might be compressed into a few minutes, hours, or days in a simulation. Likewise, time can be expanded to allow for reflection on a decision that, in a real-life situation, would have to be made immediately.[18] For example, the instructor of an ethics class may explore, from a family member's perspective, the process of deciding whether to commit a patient to life support. A simulation could be designed in which learners are assigned simulated family roles. The instructor could then give a clinical history of the simulated patient to the "family members" and ask them to discuss their decision-making process while the patient is being ventilated with a bag-valve-mask resuscitator. This simulation would give learners some idea of what it might be like to be placed in such a difficult situation.[21]

One last point regarding the characteristics of simulations must be addressed briefly—that is their design.[22] Although a full discussion of this subject is beyond the scope of this paper, the soundness of a simulation's design, as with any instructive or evaluative instrument, is a function, in part, of quality. One of the most important aspects of quality is the simulation's veracity,[22] ie, how closely does it model, in content accuracy and process, its real-life counterpart. If it is not a sufficiently true representation, then its results will be questionable. This issue becomes particularly important when the simulation is to be used for credentialing purposes.[23] The reliability and validity of simulations for evaluation has been the subject of controversy.[24-26] However, psychometric properties such as reliability and validity are qualities specific to each individual instrument, rather than to a category of instruments[27] (ie, simulations). Therefore, sound simulation design, including a high level of veracity, is essential if instructive and evaluative objectives are to be effectively met. Other important, but somewhat less crucial, design elements for computer simulations include screen layout, interactivity, use of graphic objects, ease of use, and lack of regional and cultural biases.[28]

Formats

Simulations are available and can be designed in a variety of formats and may include many types of media.[29] Clinical simulations in respiratory care are generally available in either computer, patient simulator, or latent-image format. While these 3 formats are most appropriate for testing purposes, other formats may be useful for instructive purposes. Simulations may take on elements of board games or role-playing activities. Geriatrix[30] (Upstate Medical Center College of Medicine, Binghampton NY) is an example of a role-playing game that was designed to teach sensitivity to the complexities of geriatric care. In addition to its role-playing focus, board-game elements are also included. Derrickson[31] demonstrated the effectiveness of the use of a doll in the teaching of self-suctioning techniques in children aged 5-8 years. Patient simulators are mannequins that simulate not only correct anatomy,[32] but also select physiologic properties. Sim One[33] (University of California at Los Angeles School of Medicine, Los Angeles CA) was an early, computer-controlled intubation trainer that allowed anesthesia residents to become certified in fewer days and with fewer attempts on real patients than a control group who practiced only on real patients. Hoffman[34] later summarized cost-effectiveness studies over a 2-year period and suggested that Sim One justified its cost in a short period of time. Properly designed simulations have clearly been shown to be effective learning adjuncts.[35,36]

Use

Instructional simulations have been used for the two fundamental applications of instruction and evaluation.[37-39] The effectiveness of a simulation depends upon several factors. As with any instruction or evaluation activity, it must be designed with clear goals or objectives in mind.[40,41] The degree to which a simulation is effective is directly related to how closely the simulation addresses its stated objectives. This relationship makes it imperative that an instructor perform a detailed review of a simulation prior to assigning it in a course or using it as an evaluative instrument.[27] In my experience it is not unusual for commercially available simulations to have inaccurate or outdated content or a flawed design. An additional potential for simulation malfunction exists in computer-based simulations. The potential for encountering these problems can be minimized by reviewing and testing a simulation under consideration prior to using it.[35]

Another key factor for effective use of a simulation includes the implementation of an appropriate introduction and follow-up or debriefing to the simulation.[42] As previously mentioned, active-learning exercises are not widely used in the United States. Therefore, introductory exercises that

help familiarize learners with active learning improve the chances of success for the simulation. Such exercises may include learners leading a class discussion or class reading, brief spontaneous role plays, and learner-lead equipment or procedure demonstrations.

For computer-based simulations, the introductory period should include time to learn the mechanics of using the simulation program. This is necessary because the objectives of a clinical simulation are clinical decision making and problem solving, not technical expertise at using a computer.[43] Finally, a debriefing session should accompany the use of a simulation. This allows for learner and instructor discussion of various aspects of the simulation including design, usefulness, and achievement of learning objectives.[16] Debriefing results specific to the learner include feedback from the instructor on performance strengths and skills that need improvement.

Simulations must be used judiciously. Simulations should not be used to teach new cognitive material,[44] eg, factual information such as air entrainment ratios, normal blood-gas values, and indications for mechanical ventilation. Simulations should not be used for evaluation in all situations.[45] Simulations assume that learners have a knowledge base and allow learners to practice or to be evaluated by the application of that knowledge in a simulated situation.[37] Therefore, the *application* of knowledge may be learned or assessed with a simulation, but not taught by it. Some supplemental information may be imparted by a simulation, but that is not its primary function. Other instructional or testing strategies should be used for those types of content.[24] Strategies for this use include, but are not limited to, reading, programmed instruction, and computer-based tutorial or drill-and-practice programs.

History of Clinical Simulations

Evidence of clinical simulation use dates back to the first recorded attempts at mending injured Greek soldiers during the Peloponnesian War (c. 431-404 B.C.).[46] Since that time both the veracity and sophistication have steadily improved. Much of the modern pedagogy of instructional methodology, including simulation, is based on principles outlined by Johann Comenius (1592-1670). Among those principles relevant to simulations are the correlation of media with instruction, appropriate sequencing of information, and application closely following acquisition of factual knowledge.[47] Of interest to respiratory care students is Comenius' assertion that corporal punishment should not be administered if a student fails to learn.[48] American educator Edward Thorndike (1874-1949) further expanded the importance of making connections between facts and their application.[49] The modern clinical simulation contains elements of these and other educational theories.

Prior to the advent of computer-based simulations, programmed texts and written simulations provided a similar experience. Rather than transparently advancing to different parts of the simulation as in the computer-based model, programmed texts ask the learner to turn to a specific page number based on responses to questions. The learner may use some or all of the text depending on what responses are made. The NBRC's Clinical Simulation Examination uses a modification of this model.[50] Latent-image technology allows the simulations to be scored. The learner passes a latent-image pen over the apparently blank area containing a requested response. The response then appears to the learner. Once developed, the choice cannot be taken back. The simulation is scored based on the responses developed by the learner. This technique is suited to testing, but not to learning. Once a latent-image simulation has been used it cannot be used again because responses are permanently revealed. Programmed texts that do not use latent-image technology can be used repeatedly assuming that the text is not written on.

The replacement of the Oral Examination, first used in 1960,[50] with the Written Clinical Simulation Examination by the NBRC in 1979, ushered in an era of improved validity and objectivity in the assessment of clinical problem-solving skills. The inherent and unavoidable examiner bias, however well intentioned the examiner, was reason enough to replace the Oral Examination to say nothing of the logistical problems of administering it, the backlog of examinees, and the expense incurred by candidates traveling to the test site. The Veizaga court case against the NBRC in the late 1970s,[50] that was ultimately shown to be unfounded, nonetheless, forced the NBRC to examine its procedures and improve its examinations' validity and relevance to the exemplary instruments they are today. Other workers contributed to this process including Kacmarek[51] who showed that performance on the registry written examination had a positive association with performance on the clinical simulation examination, while length of experience produced a negative association. More recently, other groups have found the oral examination format useful; however,[52] this appears to be due, at least in part, to improved examiner training and increased emphasis on patient-centered, clinical problem solving during the oral examination.

Computer-based simulations began to appear in the 1960s with the advent of increased computing power and ease of use based on standards of the time. Reports of their development and use began to appear about 1968.[33] Early reports suggested high effectiveness ratings, but based their findings on student surveys that did not measure actual learning.[18,53] Outcome comparisons began to appear around 1975 when an early use of a knowledge system in conjunction with a clinical problem-solving exercise was reported.[54] Other reports supporting the effectiveness of computer-based simulations include a comparison of mortality in simulated versus real patients.[55] The simulated patients had a lower mortality rate, but this may be due, in part, to the fact that early, computer-based simulations did not always incorporate unexpected, but real-life, results such as losing a patient in spite of doing everything right. Incor-

porating a function like this would pose a problem for the learner. The learner may wonder, "How do I know whether I did it right if the patient died?" This illustrates the need for an in-depth, post-simulation debriefing session.[16]

The ability to distribute computer-based simulations to many people was realized with the advent of the Apple computer in the late 1970s.[56] The introduction of the IBM Personal Computer (PC) in 1981[56] turned desktop computing into an industry. The increase in distribution allowed larger and more varied groups to be studied.[57] In addition to showing improved learning and performance through the use of computer-based simulations,[10,11,15] the learning of the problem-solving process itself was also shown to improve.[12]

The quality of computer-based simulations has continued to improve due to advances in technology and design techniques. Early computer-based simulations were text-based,[18,58,59] and crude graphics began to appear in the early 1980s.[60,61] By the mid-to-late 1980s, computers began to feature multimedia capabilities to include text, sound, graphics, animation, and video.[23] The 1990s have seen a continuing increase in computing power and ease of use, with a concurrent decrease in program size and cost. The expansion of the Internet has dramatically increased the distribution and opportunity for access to a wide variety of information resources, including simulations (Fig. 1).

Internet-Based Clinical Simulation Sites

Kansas University Medical Center—
http://www.kumc.edu/SAH/resp_care
Medscape—http://www.medscape.com
National Library of Medicine—http://www.nlm.nih.gov
Virtual Hospital—http://vh.radiology.uiowa.edu
WebDoctor—
http://www.gretmar.com/webdoctor/CMESims.html

Fig. 1. Currently available web sites for clinical simulations.

that format.* However, the current clinical simulation format reliably predicts practitioner competency.†

Clinical simulations will continue to be produced in written format at least as long as the NBRC continues to use this format as its standard. Clinical simulations have certainly proven useful in demonstrating competency. However, the clinical simulations are somewhat limited in what they can test. Some of the newer, computer-based clinical simulations (Fig. 2) incorporate animation, graphics, photographs, and video. The use of these media in simulations enhances the education experience and allows for the testing of clinically relevant skills and concepts. For example, using a digitized photograph of a chest radiograph in a simulation allows interpretation *and* application to be tested rather than *just* application as is the case if the learner is only given a text interpretation of the film (Fig. 3A). Viewing a video segment of an asthmatic in acute respiratory distress is both more effective and more powerful than simply reading a text description of the same clinical situation.[63] Computer-based testing is being seriously considered by the NBRC, but is several years away in terms of implementation.‡ However, because a move to computer-based testing would mean a significant increase in cost to the examinee, a cost-benefit analysis will be undertaken prior to a final implementation decision.§

Computer-Based Clinical Simulation Vendors

Applied Measurement Professionals	913-541-0400
Branching Logic Simulations Inc	800-254-6746
DataStar	403-463-3327
Hyperactive Software	206-649-0091
IMG Inc	800-571-5444
MedEd	702-656-1199
Medsoft Ranier	912-656-5681
SUMMETRIC Interactive Software	208-375-1947
Williams & Wilkins	800-528-4422

Fig. 2. Manufacturers of computer-based clinical simulations.

Where Are We Today?

In some respects, clinical simulations in respiratory care today have changed a great deal; and in others, very little. The NBRC's clinical simulation design and format has changed very little since its introduction in 1979. The simulations are almost entirely text-based with the occasional ventilator waveform, electrocardiograph, or hemodynamic tracing. Their format is unchanged. The written, latent-image technology is still in use. Computer-based simulations for competency testing are being used in medicine[62] and nursing.[38] The NBRC is currently exploring the feasibility of offering its exams in

Traditional computer-based simulations in respiratory care were text based with the occasional electrocardiogram or hemodynamic tracing. Computer simulations in respiratory care

*Benjamin George and Stephen K Bryant, NBRC, 1997: personal communication.

† Stephen K Bryant, NBRC, 1997: personal communication.

‡ Benjamin George and Steven K Bryant, NBRC, 1997: personal communication.

§ Steven K Bryant, NBRC, 1997: personal communication.

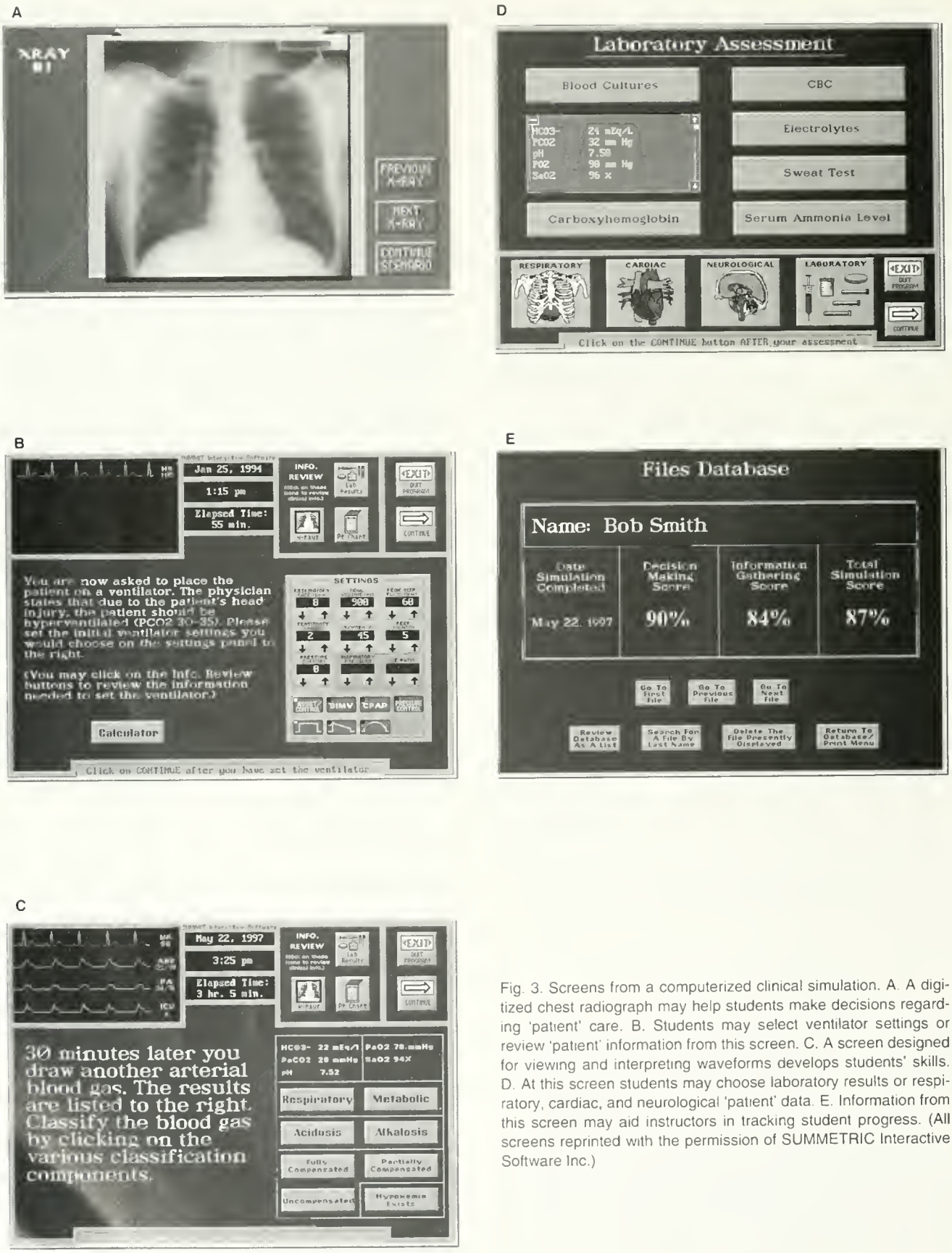

Fig. 3. Screens from a computerized clinical simulation. A. A digitized chest radiograph may help students make decisions regarding 'patient' care. B. Students may select ventilator settings or review 'patient' information from this screen. C. A screen designed for viewing and interpreting waveforms develops students' skills. D. At this screen students may choose laboratory results or respiratory, cardiac, and neurological 'patient' data. E. Information from this screen may aid instructors in tracking student progress. (All screens reprinted with the permission of SUMMETRIC Interactive Software Inc.)

have taken computer-based simulations to another level (Fig. 2). In addition to including digitized photographs of chest x-rays (Fig. 3A), a number of other design improvements are present. Figure 3B shows a screen from a computer-based clinical simulation (SUMMETRIC Interactive Software, Inc. Boise ID). At this stage in the simulation, the user is being asked to make a decision regarding ventilator settings. In addition to the decision-making focus of the screen, an information section is included allowing the user to review all information already gathered. Some older simulations did not allow this level of backtracking. Information either had to be remembered or written down, defeating one of the purposes of computer-based media. Current examples are more realistic as all patient information—laboratory test results, x-rays, and the patient's chart—would be available to the clinician during a real decision-making activity.

Computer simulations may also allow the user to select each ventilator setting independently, rather than choosing from a list of predetermined combinations (Fig. 3B). Realism may be added by the inclusion of a simulated elapsed timer. This adds some pressure to the user because the time allowed to reach a decision is not infinite as in older simulations and more closely models a real-world situation. Some simulations include an on-line calculator to assist the user in the selection of ventilator settings and in interpreting diagnostic data. The use of graphics (Fig. 3C) adds to the realism and flexibility of a program as it allows interpretation and application abilities to be assessed. An information gathering screen (Fig. 3D) may help users choose patient information from categorized laboratory, respiratory, cardiac, and neurologic sections. Some manufacturers may add a user database function (Fig. 3E) that allows the instructor or administrator to track student progress and print rosters and certificates of completion.

The biggest disadvantages of computer-based clinical simulations are related to technical problems and limitations of computer hardware and software and the limited experience of users. Unlike medical equipment, much computer hardware is not standardized.[64] This causes frequent problems with compatibility, ie, a simulation written on one computer system may not work on a similar system. Causes of incompatibility can be small or large and can be difficult to track down even for an experienced user.

Other significant problems with computer-based media include cost and the rapid upgrade rate of computer hardware and software. Operating systems and hardware components are updated at the discretion of the manufacturer and rarely take into account the end user's ability to purchase the update. Many times the end user does not need the updated capabilities of the products. However, the end user is eventually forced to update because the manufacturer eventually discontinues support of the older product. In addition to increasing purchase costs, the frequent updates can also increase development time when the simulations must be reformatted or redesigned for the updated hardware and/or software. Planned obsolescence is not new in the business world, but its accelerated pace in the computer industry makes long-range planning difficult.[65] The computer-based clinical simulation is, however, effective and engaging enough to still be worth the effort in spite of its problems.

Where Will We Want To Go Tomorrow?

The two most important directions for the future are enhanced availability via the Internet and the further development and evolution of virtual reality. Of course, the Internet and virtual reality are in use today, but their potential is just beginning to unfold. The rapid advance of technology, while a logistical problem, will allow the Internet and virtual reality to realize their full potential. Faster processors, improved graphic resolution, and more powerful design tools will enhance this process.

Despite all the media attention it has received, the Internet is still a relatively minor information resource for most people, less than 1% of all U.S. citizens have access to it.[66] It is also somewhat unwieldy, slow, and unreliable. Outages are a regular occurrence.[67] It is also subject to the frenetic upgrade schedule that rules the rest of computer serfdom. These issues notwithstanding, many universities and private concerns have put the Internet to good use.[68-70] The Virtual Hospital <http://indy.radiology.uiowa.edu/VirtualHospital.html> at the University of Iowa is one of many educational institutions offering on-line educational resources (Fig. 1), including clinical simulations, to users. Most of the Virtual Hospital's services are free, but there are sites that require a fee. Finally, use of the Internet for real-time conferencing in place of more expensive video conferencing[71] may offer another avenue for increased availability of clinical simulations. The NBRC is currently considering the implementation of Internet-based self-assessment, but not testing, as well as on-line application for its examinations.*

In addition to the rich graphics, sound, photographs, and video currently in use by many education Internet sites, virtual reality applications are beginning to emerge and should continue to grow in quality and quantity.[72] Virtual reality is a term coined by Jaron Lanier in 1989.[73] It refers to a computer-generated representation of an artificial environment. This environment could be as simple as a simulated three-dimensional computer game or as complex as a fully immersive, simulated environment. Its early development was supported primarily by the Department of Defense and saw application in aircraft, tank, and war simulators.[74] Medical applications have shown much promise.[75,76] Vining[77] used computer-tomography imaging data to construct a 'virtual tracheobronchial tree' and compared the 'virtual bronchoscopy's' findings with those

*Steven K Bryant, NBRC, 1997: personal communications.

of an actual bronchoscopy on the same patient and found that they were essentially the same. The implication is that there may be application in education or preprocedure evaluation. Telepresence surgery, originally developed for the military, promises to be a viable option for patients in remote locations.[78] A physician in a referral medical center could operate on a patient in a remote location. The physician, through virtual reality, would control a robot at the remote location. The robot's 'eyes' are cameras, and 'ears,' microphones; the robot transmits what it 'sees' and 'hears' back to the physician. The robot's gloves are pressure sensitive and transmit what they 'feel' back to the gloves the physician is wearing. Theoretically, the physician's sight, hearing, and tactile sensations are equivalent to what would be felt if the physician were performing the surgery on-site. This technology is relatively new and has some technical and health problems.[79,80] For example, what happens if the communications signal to the robot is interrupted? What happens if the robot malfunctions? What happens if someone accidentally disconnects the robot's power cord? These technical, as well as ethical, questions—Who gets access to it?, How much will it cost?, Who pays for it?—must be answered before this virtual-reality application can be widely used.[81]

Another important question must be considered when evaluating virtual reality for education use and that is transfer of training. Kozak[82] showed that the ability to learn and become proficient at a task in virtual reality does not necessarily mean that proficiency will transfer to the real world. More work needs to be done to determine the usefulness of virtual reality in education.

Lastly, several serious adverse health effects have been noted with the use of virtual reality.[83,84] These effects appear to worsen as the veracity and level of immersion increases and may occur in up to 30% of the population.[44] Users of virtual reality may experience such adverse health effects as nausea, headache, disorientation, loss of balance, and flashbacks.[83] Pilots have experienced flashbacks, the illusion of being back in the aircraft simulator, up to 12 hours after using it. One pilot reported the experience while driving a car.[83] Due to the obvious safety risk, military pilots are required to stay under observation for 24 hours after aircraft simulator use. This may be the result of insufficient veracity,[84] (that is, the immersive experience, as real as it *seems*, is not yet real *enough* to avoid its side effects). Perhaps these effects will disappear when the virtual world is as rapid and graphically realistic as the real world.[84]

Summary

Simulations in health care are established, effective, and powerful instructive and evaluative tools. They allow the exploration of clinical situations that can be too costly, time consuming, or risky for student use. They can be a source of great motivation and meaningful experience. Their usefulness derives from the designer's ability to manipulate the learner's level of participation and safety as well as to control logistic and time elements of the simulated experience. Simulation formats range from written to mannequin to computer-based with varying applications based on learning objectives. They are primarily used for instruction or evaluation with design characteristics appropriate to their intended use.[85] The proper use of simulations must be stressed. They are not useful in all situations, and the instructor or examiner should consider all available strategies before implementation.

Reported use of clinical simulations dates back to the Greek empire. The dissemination of a number of education theories has contributed to the development of the clinical simulation. The clinical simulation was introduced to the respiratory care credentialing system in 1979 and has continued to develop in that capacity. Clinical simulations, in written and computer format, have been a mainstay of respiratory care education since then and have continued to see improvement in design quality. Future directions include access to simulations on distributed computing environments through the Internet and other networks and the continued development and application of virtual reality.

ACKNOWLEDGMENTS

I thank Stephen K Bryant and Benjamin George of the National Board for Respiratory Care for their personal insight and Andrea Bé for her assistance in the preparation of the manuscript.

REFERENCES

1. Hubbard JP. Measuring medical education: the tests and experience of the NBME. Philadelphia: Lea & Febiger; 1978.
2. Rosen HK. Clinical simulation examination of the NBRT: is it better than the oral examination?. Respir Ther 1983;13(1):59-60,63.
3. Rennels GD, Shortliffe EH. Advanced computing for medicine. Sci Am 1987;257(4):154-161.
4. Tritz GJ. Computer modeling of microbiological experiments in the teaching laboratory: animation techniques. J Comp Math Sci Teaching 1987;6(2):44-48.
5. Maatsch JL. Examiner assessments of clinical performance: What do they tell us about clinical competence? Eval Program Planning 1987;10(1):13-17.
6. Kacmarek RM. The predictive validation of the clinical simulation examination: respiratory care practitioners. AARTimes 1985;9(5): 18-19.
7. Keegan M Scenario educationa software: design and development of discovery learning. Engle wood Cliffs NJ: Educational Technology Publications; 1995.
8. Anderson EJ. Active learning in the lecture hall. Journal of College Science Teaching 1997;26(5):428-429.
9. DeNeve KM, Heppner MJ. Role play simulations: the assessment of an active learning technique and comparison with traditional lectures. Innovative Higher Education 1997;21(Spring):231-246.
10. Garrett TJ, Ashford AR. Computer-assisted instruction in patient management for internal medicine residents. J Med Educ 1986;61(12): 987-989.
11. Harless WG. A voice-activated, interactive videodisc case study for

use in the medical school classroom. J Med Educ 1986;61(11): 913-915.
12. Diserens D, Schwartz MW, Guenin M, Taylor LA. Measuring the problem-solving ability of students and residents by microcomputer. J Med Educ 1986;61(6):461-466.
13. Meredith RL, Pilbeam SP, McCarthy K, Stoller JK. Proficiency among respiratory therapy educators, staff, and students in using algorithms for therapist-driven protocols. Respir Care 1996;41(7):595-600.
14. Cloutier MG, Cowan ML. Disaster medicine training through simulations for fourth-year students. J Med Educ 1986;61(5):408-410.
15. Norman GR, Nuefeld VR, Walsh A, Woodward CA, McConvey GA. Measuring physicians' performances by using simulated patients. J Med Educ 1985;60(12):925-934.
16. Norman GR, Tugwell P, Feightner JW. A comparison of resident performance on real and simulated patients. J Med Educ 1982;57(9): 708-715.
17. Maude DL. Acid-base disorders—a computer simulation. Physiologist 1985;28(2):118-121.
18. Farquhar BB, Votaw RG. Current trends in computer-based education in medicine. Educ Technol 1978;18(4):54-56.
19. Kaye W. Research on ACLS training—which methods improve skill and knowledge retention? Respir Care 1995;40(5):538-549.
20. Schreiner RL, Stevens D, Gosling CG, Sternecker CL, Gresham EL. Simulators to teach pediatric skills. J M Educ 1979;54(3):242-243.
21. Wilson CC, Netting FE, Henderson SK. Gaming as a method for learning to resolve ethical dilemmas in long term care. Health Educ 1988; 19(1):42-44.
22. Holzman RS, Cooper JB, Gaba DM, Philip JH, Small SD, Feinstein D. Anesthesia crisis resource management: real-life simulation training in operating room crises. J Clin Anesth 1995;7 (8):675-687.
23. Engberg SJ, White JE, Belle S. Establishing criterion validity of a computer-based clinical simulation. Proc Annu Symp Comput Appl Med Care 1991:737-741.
24. LaDuca A. The structure of competence in health professions. Eval Health Professions 1980;3:253-288.
25. Swanson DB. Evaluation of professional competence: written and computer-based simulations. Prof Educ Researcher Notes 1984;6(1): 9-14.
26. Holzemer WL, Resnik B, Slichter M. Criterion-related validity of a clinical simulation. J Nurs Educ 1986;25(7):286-290.
27. Cavanaugh SH, Loadman WE. The dimensionality of measures derived from a nationally standardized written clinical simulation examination. Eval Health Professions 1988;11(3):333-357.
28. Bersky AK. Effect of audiovisual enhancement on problem-solving and decision-making activities during a computerized clinical simulation test (CST™) of nursing competence. Eval Health Professions 1994;17(4): 446-464.
29. Corvetta A, Pomponio G, Salvi A, Luchetti MM, Leven FJ. Hypertext application and clinical simulation: innovative approaches in computer aided teaching of medicine. Lecture notes in medical informatics 1990;40:406.
30. Hoffman SB. Geriatrix: a role-playing game. Gerontologist 1985;25 (6):568-572.
31. Derrickson JG, Neef NA, Parrish JM. Teaching self-administration of suctioning to children with tracheostomies. J Appl Behav Anal 1991;24(3):563-570.
32. Reimers TM, Vance MD, Young RJ. Teaching self-administration of nasogastric tube insertion to an adolescent with Crohn disease. J Appl Behav Anal 1995;28(2):231-232.
33. Abrahamson SA, Denson JS. A developmental study of medical training simulators for anesthesiologists, final report. Los Angeles: UCLA School of Medicine; 1968.
34. Hoffman KI, Abrahamson S. The 'cost-effectiveness' of Sim One. J Med Educ 1975;50(12, Part 1):1127-1128.
35. Wong J, Wong S, Richard J. Implementing computer-simulations as a strategy for evaluating decision-making skills of nursing students. Comput Nurs 1992;10(6):264-269.
36. Rubens AJ. Testing airway management skills: interactive video courseware vs ACLS instructor. Respir Care 1991;36(8):849-856.
37. Fitzgerald JT, Wolf FM, Davis WK, Barclay ML, Bozynski ME, Chamberlain KR, Clyman SG, Shope TC, Woolliscroft JO, Zelenock GB. A preliminary-study of the impact of case specificity on computer-based assessment of medical-student clinical-performance Eval Health Professions 1994;17(3):307-321.
38. Bersky AK, Yocom CJ. Computerized clinical simulation testing: its use for competence assessment in nursing. Nurs Health Care 1994; 15(3):120-127.
39. Molino G. A computer-based approach to education and training in clinical gastroenterology. Scand J Gastroenterol Suppl 1991;189:27-29.
40. Richards JM, Goetter WE, Amos PA. Validity of the allied health aptitude test in a respiratory therapy education program. Educ Psychol Meas 1986;46:397-400.
41. Reinecker L. Computerized clinical simulations. Comp Educ 1985;9(1): 57-66.
42. Kues JR. The development and use of gaming in multidisciplinary geriatric education. Educ Gerontol 1992;18(1):27-40.
43. Felciano RM. Multimedia clinical simulation based on patient records: authoring, user interface, pedagogy. Proc Annu Symp Comp Appl Med Care 1994;18:59.
44. Schell JW. A framework for learning advanced postsecondary vocational-technical skills. Comm College J Res Practice 1993;17(4):357-374.
45. Henry SB, Holzemer WL. The relationship between performance on computer-based clinical simulations and two written methods of evaluation: cognitive examination and self-evaluation of expertise. Comp Nurs 1993;11(1):29-34.
46. Saettler P. The evolution of American educational technology. Englewood CA: Libraries Unlimited Inc; 1990:24,27.
47. Saettler P. The evolution of American educational technology. Englewood CA: Libraries Unlimited Inc; 1990:28-30.
48. Saettler P. The evolution of American educational technology. Englewood CA: Libraries Unlimited Inc; 1990:30.
49. Saettler P. The evolution of American educational technology. Englewood, CA: Libraries Unlimited, Inc., 1990:54-56.
50. Smith GA. Respiratory Care: Evolution of a Profession. Lenexa KS: Applied Measurement Professionals Inc; 1989.
51. Kacmarek RM. The effects of both experience and education on performance on the National Board for Respiratory Care clinical simulation examination (validity, PMPs, branching logic problem). Doctoral dissertation;DAI 45-12A:3586. Chicago: Northwestern University; 1984.
52. Solomon DJ, Reinhart MA, Bridgham RG, Munger BS, Starnaman S. An assessment of an oral examination format for evaluating clinical competence in emergency medicine. Acad Med 1990;65(9, Suppl):S43-S44.
53. Voss G. Computer-assisted instruction in medicine: a German view. (conference paper). March 1978. Annual Meeting. Bellingham WA: Association for the Development of Computer Based Instructional Systems; 1978.
54. Conzelman GM. The use of computer-based data banks in the teaching of clinical problem-solving and medical case management to veterinary students. J Vet Med Educ 1975;2(2):20-23.
55. Palva IP, Korhonen V. Validity and use of written simulation tests of clinical performance. J Med Educ 1976;51(8):657-61.
56. Cringely RX. Accidental empires: how the boys of Silicon Valley maker their millions, battle foreign competition, and still can't get a date. New York: Harper-Collins; 1996.
57. Friedman CP. Anatomy of the clinical simulation. Acad Med 1995; 70(3):205-209.
58. Ehrlich LR. The design, development, and evaluation of an evaluative computer simulation. (conference paper) March 1979. Annual

convention. Washington DC: Association of Educational and Communications Technology; 1979.
59. Crocco JA, Rooney JJ, Diamond HS, Plotz CM, Weiner M. A computer-assisted instruction course in the diagnosis and treatment of respiratory diseases. Am Rev Resp Dis 1975;111(3):299-305.
60. Gaar KA. A simple model of the pulmonary circulation for hemodynamic study and examination. Physiologist 1983;26(6):390-393.
61. Modell HI, Olszowka AJ, Plewes JL, Farhi LE. Role of computer graphics in simulations for teaching physiology. Physiologist 1983;26 (2):93-95.
62. Clyman SG, Orr NA. Status report on the NBME's computer-based testing. Acad Med 1990; 65 (4):235-41.
63. Harless WG, Duncan RC, Zier MA, Ayers WR, Berman JR, Pohl HS. A field test of the TIME patient simulation model. Acad Med 1990;65(5):327-333.
64. Langdon W, Braley G. Client/server RIS: assessing the risks. Health Care Informatics 1996;13(11):70-72,74.
65. Nichols J. Ten reasons you need a health care information systems integrator. Health Care Informatics 1996;13(9):26,28,30.
66. Mason J. Finding health resources on the Internet—the departure lounge. Health Econ 1996;5(4):375-379.
67. Barrett R, Vonder Harr S, Whitestone R. Routing snafu snips Net service. Interactive Week April 28, 1997; 4(13):5.
68. Feenberg AL, Licht JM, Kane KP, Moran K, Smith RA. The on-line patient meeting. J Neurol Sci 1996;139(Suppl):129-131.
69. Greek C, Gilbert S. Displaying medical illustrations on the Internet. J Biocommun 1996;23(3):30-32.
70. Shortliffe EH, Barnett GO, Cimino JJ, Greenes RA, Huff SM, Patel VL. Collaborative medical informatics research using the Internet and World Wide Web. Proc AMIA Annu Fall Symp 1996: 125-129.
71. Barrett R. Telemedicine on the rise on the Internet. Interactive Week;4(15):1,58-59.
72. Hoffman H, Irwin A, Ligon R, Murray M, Tohsaku C. Virtual reality-multimedia synthesis: next-generation learning environments for medical education. J Biocommun 1995;22(3):2-7.
73. Hayward T. Adventures in virtual reality. Carmel IN: QUE Corporation; 1993:47.
74. Franchi J. Virtual reality: an overview. TechTrends 1994;39(1):23-26.
75. Hon D. Ixion's realistic medical simulations. Virtual Reality World; July/Aug 1994:58-62.
76. Meredith W. Virtual reality for patients with spinal cord injury. MD Comput 1996;13 (5):400-405.
77. Vining DJ, Liu K, Choplin RH, Haponik EF. Virtual bronchoscopy. Relationships of virtual reality endobronchial simulations to actual bronchoscopic findings. Chest 1996;109(2):549-553.
78. Satava RM. Virtual reality and telepresence for military medicine. Comput Biol Med 1995;25(2):229-236.
79. Pinciroli F, Valenza P. An inventory of computer resources for the medical application of virtual reality. Comput Biol Med 1995;25(2):115-125.
80. Satava RM. Medical applications of virtual reality. J Med Syst 1995; 19(3):275-280.
81. Whalley LJ. Ethical issues in the application of virtual reality to medicine. Comput Biol Med 1995;25(2):107-114.
82. Kozak JJ, Hancock PA, Arthur EJ, Chrysler ST. Transfer of training from virtual reality. Ergonomics 1993;36(7):777-784
83. Viirre E. A survey of medical issues and virtual reality technology. Virtual Reality World; July/Aug 1994:16-20.
84. Strauss S. Virtual reality too real for many. Globe and Mail;March 4, 1995:A1+.
85. Ramsey D. Evaluation of surgical resident applications using simulated patients. Evaluation and Program Planning 1987;10(1):9-12.

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ACLS Review.* System requirements: CD-ROM—an MPC 2-compliant computer, minimum 486SX25 with 4 MB RAM, SVGA/256 color display, sound card (Sound Blaster® 16 or equivalent), speakers and a double-speed CD-ROM. Diskette—PC with Microsoft Windows™ 3.1, minimum 36SX25 with 2 MB RAM, SVGA/256 color display. St Louis: Mosby-Year Book Inc; 1995. $99.

Mosby Electronic Library: The ACLS Omnibus Resource.† System requirements: Macintosh—Macintosh Operating System 6.0.7 or later, 2 MB RAM required, 4 MB recommended and required for use with System 7, hard disk drive with at least 2 MB free, CD-ROM installed with driver software. Windows—Windows 3.0 or higher, IBM 386/33 (or higher) or equivalent PC, VGA graphics monitor, 4 MB RAM, hard disk drive with at least 2 MB free, a mouse, CD-ROM installed with driver software. St Louis: Mosby-Year Book Inc; 1995. $99.

Virtual Physician: The Flight Simulator of Medicine/ACLS Simulator.‡ System requirements: 486SX25 MHz processor, Windows 3.1 or higher in 386 enhanced mode, 8 MB RAM (16 MB RAM recommended), 9.5 MB-free hard disk, sound card, double-speed CD-ROM drive, SVGA monitor with 800×600 resolution display capabilities. New York: Churchill Livingstone; 1996. $250.

All of these CD-ROM-based resources are designed to teach a clinical approach to patients suffering cardiac arrest and to help prepare students for the American Heart Association's Advanced Cardiac Life Support (ACLS) program. They are different and complimentary in several ways.

ACLS Review by Mosby consists of **Mosby's Electronic Library: The ACLS Omnibus Resource** and a clinical, scenario-based teaching program. The **Omnibus Resource** consists of the complete text versions of several popular texts: *ACLS—A Comprehensive Review*, Volumes I and II, by Ken Grauer and Daniel Cavallaro, and *ACLS: Quick Review Study Guide* by Barbara Aehlert. Also included is a collection of slides that accompany the standard lectures. The textual material is enhanced with many short video and audio clips illustrating some of the teaching points. Mosby uses the versatile Folio® system to search and store material in a shadow file that can be customized by the user. This system allows rapid access to any part of the file material and creates a return path for future reference. Highlighting, user-defined bookmarks, and 'sticky' notes are features of the Folio interface. Learning to use the computer interface is easy and can quickly be mastered. Other CD-ROM materials by Mosby and other publishers also use this interface.

The only significant content difference between the published texts and the **ACLS Omnibus Resource** are the added audio-visual aids. These are small (<2 in.^{2}), short (10-30 s), and of low resolution. They require a video viewer, Runtime®, which is installed during the setup process. Because of the sequential nature of ACLS treatment and study, using the **ACLS Omnibus Resource** adds little practical advantage over the original hard copy material for the beginning student. **ACLS Review** combines the same textual material with a programmed, simulated-video ventricular arrest scenario and a comprehensive review guide of ACLS concepts. Additionally, there is a library of questions on the material for self-assessment. The program is easy to install on a MAC or an IBM-compatible personal computer. The information booklet states that the program takes only 2 MB of hard disk space but after installation it had consumed more than 20 MB. It runs slowly on less than a quad-speed CD-ROM drive.

The Virtual Physician: The Flight Simulator of Medicine/ACLS Simulator takes a different tact to help students master management of a cardiac arrest scenario. There are several modules in this CD-ROM program. In the Lecture Module, the material is presented in lecture format. This can be heard or read from the computer screen as text. The lecture content also can be searched for key words or topics if review of a specific area is desired. The presentation format is not identical to the *American Heart Association's ACLS Textbook*, but the main points are highlighted and covered in the Lecture Module. Unlike the ACLS Manual, there are no primary references supporting the statements and concepts proposed.

The 'heart' of the program is the Patient Simulation Module. In this section, the user practices the mechanics of resuscitation. A model patient and a 'tool' kit, that must be manipulated with a mouse, are used to teach the resuscitation sequences. Distracters are part of the simulation and include the background noises of the confusion in an emergency room and "the test results are not back yet" and "no x-ray is available" when these are requested by the student. A time log of activity is kept and can be stored for later review or for grading by an instructor. After learning to manipulate the equipment and step-by-step management of known arrhythmias, the student can attempt to treat an 'unknown' patient. Failures are identified and 'remedial' education can be obtained from the programmed sequences or the lectures. Repeated practice can be performed until all elements of the resuscitation are correctly executed.

The patient treatment interface is high-tech; however, the management process is more like a video game than an actual cardiac arrest. Success is more dependent on knowing the particular computer moves than the patient treatment decisions. It took me several attempts to successfully complete one cardiac arrest situation despite the fact that I frequently participate in actual resuscitations and have been an ACLS instructor for many years. My errors were all related to using the tools and the model, not trying incorrect treatment algorithms. Another problem with this system is that there is only one correct way to treat each of the scenarios, unlike the ACLS concept that the algorithms are guidelines from which to start. A single series of 60 multiple-choice questions completes the teaching modules. There is immediate feedback on answer accuracy. The questions are all patient-based with a brief clinical scenario,

*Available from Mosby-Year Book Inc, 11820 Westline Industrial Drive, St Louis MO 63146-3318, (800) 426-4545.

†Also available from Mosby-Year Book Inc.

‡Available from Churchill Livingstone, 650 Avenue of the Americas, New York NY 10114-0638.

and many have selectable information to help arrive at the correct answer.

For physicians using this program, CME (continuing medical education) credit can be obtained from Churchill-Livingston and the American College for Emergency Physicians, co-developers of the program. The program was easy to install. It requires a serial number (not on the disk), and a user-defined password. It loads each module from the CD when selected. This process is rather slow even when running on a fast CD-ROM drive. It is not compatible with Macintosh machines and is not guaranteed to run under Windows 95 (although I tested it in Windows 95, and it ran without problems). The program is very particular about environment settings. It will only run with a screen setting of 800 × 600, it will not run with Windows large fonts, and the sound card must be 16-byte Sound Blaster® compatible.

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Teaching in the Health-Related Professions, by SB Dowd EdD RT (R) Illustrated, 278 pages, 4 appendices, index, and bibliography. Durham NC: Carolina Academic Press; 1997. $29.95.

Teaching in the Health-Related Professions is a title that requires a quick survey of the preface, table of contents, and index for the reader to ascertain what topics are covered and for whom the book is intended. The author's focus is confined to the allied-medical professions rather than nursing and medicine. In reading the text, one discovers that the author attempts to include relevant citations from the literature of medicine and nursing to support his topics. This is also true for the topics of general and adult education, from which several findings are reported. Including these examples is helpful because it offers an opportunity for allied-medical professionals to read some of the literature from large instructor groups who deal with health competencies and adult learners.

Teaching in the health-related professions includes inservice teaching and patient-caregiver instruction. According to the book's Preface, the discussion and examples in the book are intended to provide "topics that are common and valuable to clinical and classroom instructors." Patient-caregiver and inservice teaching are absent from the table of contents, index, and illustrations. Considering the emphasis that the Joint Commission for Accreditation of Healthcare Organizations places on these aspects, it would be helpful for the author to address these because they have been poorly supported in the allied-medical literature. Directions on how to conduct adequate skills laboratories and competency evaluations of employees and caregivers would make fine additions for a second edition.

The author includes many topics that are germane to the allied medical teaching professional. Chapter 1 concentrates on curriculum development. Chapter 2 covers the 'softer side of health care,' ie, ethics (12 ethical case studies are included in an appendix) and caring. Chapter 3 provides a "profile of the instructor," listing what research has indicated as characteristics of best and worst instructors. The chapter also suggests routes for faculty development in teaching. Chapters 4 through 7 cover specific instructor skills: test construction, use of adult education principles, presentation and materials skills, and use of computers. The book concludes with chapter presentations on use of creative and critical thinking and planning for the future. An appendix contains a strategic planning survey that can be modified for use in other disciplines.

There are two weaknesses to the book. The author uses some chapters to review several research or opinion pieces from the literature and several well-placed tables and figures to summarize these. However, at times the author's efforts come across like a library research paper, with the neutral tone, 'he said this' and 'they said that.' It is difficult for me to know exactly where the author stands on issues or which piece of research is most useful for the teaching professional and how it may apply in practice.

The second weakness is, that in spite of his efforts to make the book useful to all instructors in health-related professions, the author includes too many references and applications from his own discipline of the imaging sciences. Dowd is the Program Director for the Radiographer Program in the Division of Medical Imaging and Therapy at the University of Alabama at Birmingham. His background as an active allied-medical professional and educator provides many of the illustrations; many are timely and applicable to professionals in general. However, respiratory care professionals who have little contact either in training or daily practice with imaging professionals, may be uncomfortable with frequent reference to radiologic technology.

Dowd's book is a desirable contribution to the educational preparation of program faculty in the allied-medical professions. Many useful topics are covered. It is especially helpful to those who come to teaching directly from the clinical disciplines without a background in education or an opportunity to review educational issues in disciplines other than their own.

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Essentials of ACLS—Program Review and Exam Preparation, by CA Brainard and RN Glen. Softcover, 320 pages, Stamford CT: Appleton & Lange, 1997. $19.95.

This book, written by a registered respiratory therapist with contributions by an emergency physician, is divided into 13 chapters and includes pre- and post-tests with referenced answers. The chapters include ACLS (Advanced Cardiac Life Support) Course Requirements, Principles of Adult ACLS, Endotracheal Intubation and Airway Adjuncts, Defibrillation and Transcutaneous Pacemakers, Intravenous Techniques, Electrocardiology, Electrocardiographic Signs of Ischemia Injury and Infarct, Mechanisms of Arrhythmia Formation, Therapeutic Agents of the ACLS Algorithms, Lethal Arrhythmias, The Bradycardias, The Tachycardias, and The Essential ACLS Cases.

The authors state, "This text is specifically designed for pre-hospital and acute/subacute facilities health care providers preparing for an 'Essentials of ACLS' course." The text reviews the most recent guidelines and recommendations for providing adult ACLS. The authors state, "It is designed to prepare course participants for the problem-oriented, case-based ACLS educational process." The book gives frequent attribution

to the guidelines and recommendations provided by the publications:

1. *Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiac Care* by the American Heart Association (AHA), *JAMA* 1992;268:2171-2302.
2. *Textbook for Advanced Cardiac Life Support* by the American Heart Association, Dallas, Texas; 1994.
3. *Instructors Manual for Advanced Cardiac Life Support* by the American Heart Association, Dallas, Texas; 1994.

The authors deliberately limit text content to the knowledge and skills designated by the AHA Instructor's Manual for ACLS as being part of an Essential ACLS Provider course. Many of the chapters define terms first, and the authors make good use of topic headings. ACLS instructors who read this text will be impressed with the emphasis given to critical performance skills and essential information.

Chapter 1 begins with an overview of course requirements, including the education process, types of courses, and curricula for an Essentials of ACLS course. The authors introduce the 9 essential cases and algorithms, core pharmacology, and essential ACLS rhythm recognition skills. This chapter is comprehensive, outlines key points to be taught and learned, and provides strategies for organizing an ACLS course.

The history of the AHA conferences on cardiopulmonary resuscitation (CPR) and emergency cardiac care (ECC) is covered in Chapter 2. This chapter also discusses what ACLS is and why it is necessary. Also covered are: risk factors for coronary artery disease, the AHA "Chain of Survival," ACLS conceptual tools, the AHA therapeutic option classification system, the algorithm approach to ACLS and ECC.

Chapter 3 covers endotracheal intubation and airway adjuncts and related aspects of the curricula, such as the role of oxygenation and ventilation in ACLS, the Universal algorithm, essential equipment, and endotracheal drug administration. The discussion of bag-valve devices lists the standard criterion that states "an oxygen inlet valve that will not jam when oxygen flows of 15 L/min are used." This is taken from the *JAMA* reference which reads "...a nonjam valve system allowing for a minimum oxygen inlet flow of 15 L/min." I believe the intent of this AHA criterion is that the nonrebreathing valve will not jam at minimum flow of 15 L/min. The American Society for Testing and Materials and the International Standards Organization require the nonrebreathing valve to accommodate 30 L/min of oxygen flow without jamming. I would agree that 15 L/min of oxygen is all that is needed most of the time.

Defibrillation and transcutaneous pacemakers are covered in Chapter 4. I especially liked the comparisons made between conventional, automated external, and semi-automated external defibrillators. The discussion of the advantages of transcutaneous pacemakers over transvenous pacing may be useful for participants taking their first ACLS course.

Intravenous techniques are difficult to teach to health care professionals who do not normally have this responsibility. This text does a good job of introducing information on both peripheral and central vein sites and the respective lines used.

Electrocardiology (Chapter 6), Electrocardiographic Signs of Ischemia and Infarct (Chapter 7), and Mechanisms of Arrhythmia Formation (Chapter 8) are covered. The authors use illustrations to relate the pathophysiology of the heart to 6-second electrocardiograph strips. The discussions on lead placement is one of the best I have seen. The key to these 3 chapters and, actually, the entire text is that the authors know from their experience—more than 20 years—what to present. ACLS instructors who have taught and tested students on this material will recognize immediately that the authors are presenting the right 'stuff.' On Page 145, the discussion of the differences between paroxysmal and supraventricular tachycardia and atrial flutter is a good example of how this text can help participants in ACLS courses sort out arrhythmias resulting from premature ectopy.

The therapeutic agents recommended in the ACLS algorithms are covered in Chapter 9 and are nicely presented in outline form. A glossary of pharmacologic terms also leads this chapter. The chapter uses the learning strategy recommended in the AHA ACLS text—each agent is discussed in terms of the "Why (actions), when (indications), how (dosing), and watch out (precautions/hazards." These agents are grouped and presented according to the ACLS Algorithms that recommend their use.

Lethal arrhythmias (Chapter 10), bradycardias (Chapter 11), and tachycardias (Chapter 12) are presented. These chapters are organized into sections: the essential ACLS recommended curricula, discussing the clinical significance, describing with text and illustrations the arrhythmia, and finishing with the appropriate intervention sequence.

The essential ACLS cases in which all the skills and knowledge come together are presented in Chapter 13. These cases stem from the AHA Instructor's Manual for Advanced Cardiac Life Support. Each case is presented with a case setting, the scenario, critical performance skills (what one must do), appropriate algorithm, and critical errors (what one must not do).

Another reason to use this text is the pre- and post-tests, which are very well done and similar to the type of written exams used during AHA ACLS courses. The answers to the tests are referenced to the AHA texts and *JAMA* guidelines. This gives me the opportunity to point out that this book is a program review and exam preparation text. It is not meant to replace the AHA ACLS text.

The authors have accomplished their purpose—to design a book that will help health care providers prepare for an Essentials of ACLS course. This text should be required reading along with the AHA ACLS textbook for all respiratory students taking their first ACLS course. It is also a good review for practicing respiratory care practitioners updating their ACLS cards. We plan to make this a required text for cardiovascular technology, exercise physiology, and respiratory therapy students enrolled in our ACLS course at Northeastern University. To the authors, Bravo!

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Respiratory Care Pearls, by FA Mazzagatti MSA RRT; LC Lebowitz BA RRT; and NW Schluger MD. Soft cover, illustrated, 200 pages. Philadelphia: Hanley and Belfus Inc; 1997. $37.

This is the latest in The Pearls Series® that uses a case-based problem-oriented approach to teaching clinical medicine. Patients, 75, are presented in a standard format. First, there

is a clinical vignette (approximately 10-20 lines of text) consisting of a patient history, examination, laboratory data, and clinical course. Next, there is an illustration. This is usually a chest radiograph, but it may be a computerized tomographic (CT) scan, an echocardiogram, or a set of pulmonary function test results. Then, the reader is asked to make the diagnosis, explain the abnormalities, or discuss management. On the next page, the reader finds the diagnosis, a concise discussion (one-half to three-quarters of a page of text), 3 take-home teaching points (the clinical pearls), and 4 or 5 current references.

Earlier books in this series were written by physicians for physicians on such subjects as cardiology, critical care, internal medicine, pulmonary medicine, rheumatology, and tuberculosis. **Respiratory Care Pearls** is aimed at a broader audience that includes medical students, resident physicians, experienced respiratory therapists, and critical care nurses. This is timely because respiratory care practitioners rarely limit their duties to the operation of respiratory equipment and need a broader range of knowledge to work effectively with physicians, nurses, and patients. Physicians and nurses may also benefit by learning more about the nontechnical aspects of respiratory care.

The authors have commendable experience—Mazzagatti as associate technical director and Lebowitz as technical director of the Respiratory Therapy Department of the Brookdale University Hospital and Medical Center in Brooklyn, New York, and Schluger as the director of the Bellevue Hospital Chest Clinic in New York City. Even though the authors' combined experience is from two large urban medical centers with a wealth of clinical material, the authors use 16 cases from colleagues in New York, Pennsylvania, and Delaware.

The authors considered the spectrum of respiratory care. Most patients (about 80%) were seen in the emergency room or intensive care unit, about 20% were infants or children, and nearly the same proportion had infections. Several had progressive illnesses that address the need for long-term ventilatory support, and approximately 15% were seen in the ambulatory setting.

In this book, the patients are vehicles for introducing specific topics that range from common (eg, postoperative hypoxemia) to esoteric (eg, nemaline myopathy); from subtle (eg, captopril cough, phenytoin toxicity) to dramatic (eg, partial liquid ventilation, independent lung ventilation); and from general (eg, diabetic ketoacidosis) to specific (eg, inverse ratio ventilation). By intent, detailed discussions of disease, patient management, and technique are avoided.

The authors' challenge, then, is to balance content with conciseness. Given the (approximate) 700-word limit, I would indeed describe some of the discussions as 'gems:' the comparison of pressure-controlled and volume-controlled inverse ratio ventilation (Page 68), chest tube drainage systems (Page 151), patient fighting of the ventilator (Page 154), independent lung ventilation (Page 163), and cystic fibrosis in a young adult (Page 165).

This soft cover book is printed on glossy coated paper. The type and writing style are easy to read. There are only a handful of typographical errors, eg, an author's name is spelled incorrectly and correctly in the same citation (Pages 28 and 104); another author's name is spelled incorrectly and correctly in sequential citations (Page 35); the control value for the prothrombin time is misplaced—it follows the partial thromboplastin time (Page 127); and a case history describes a "67-year-old boy" (Page 168).

A few of the chest radiographs are hard to read. A single enlarged CT view would better demonstrate tracheal stenosis than the 12 tiny CT views used on Page 52 (this was done effectively on Page 98 for a patient with fibrosing mediastinitis) and the endotracheal tube is not well seen in the case of a right mainstem intubation (Page 175). On occasion, the illustration is not consistent with the discussion, for instance, the 'clinical pearl' for croup and epiglottitis recommends a lateral neck view, yet an anteroposterior view is shown (Page 112).

I was disappointed by the minimal attempts to provide continuity. The discussion of Patient 24 (polypharmacy drug intoxication) refers to that for Patient 9 (toxic ingestion), and the discussion for Patient 55 (upper airway burn) refers to that for Patient 26 (smoke inhalation and carbon monoxide poisoning). Tying discussions together is important because it builds on past knowledge and reinforces important concepts. The authors could have done this with the following patient pairs: 12 and 41 (obstructive sleep apnea/Pickwickian Syndrome); 43 and 71 (pulmonary fibrosis due to oxygen toxicity/adverse effects of oxygen therapy); 3 and 57 (ventilatory failure from combined kyphoscoliosis and COPD/ventilatory failure from kyphoscoliosis); 40 and 66 (nemaline myopathy/Duchenne muscular dystrophy); and 45 and 50 (acute epiglottitis/croup).

When there are few threads of continuity, the reader must rely on the index. Fortunately, the index is good. Page numbers are printed in bold type to identify the cases devoted to the indexed topic. The listings for obstructive sleep apnea are stilted (they follow the pattern: A, see B; B, see C; C, see A). Nemaline myopathy, a rare congenital disease with little name recognition, is listed alone instead of under muscle weakness.

Many readers will benefit from discussing the cases with a senior physician. This is important because the discussion usually does *not* explain the illustrations and abnormal test results. For example, the echocardiogram for Patient 20 (patent ductus arteriosus) shows the persistent aorta-pulmonary artery connection and blood flowing during both systole and diastole; the chest radiograph for Patient 53 does not show the characteristic changes of acute silicosis; and the chest radiograph of Patient 29 (infant respiratory distress syndrome requiring extracorporeal membrane oxygenation) shows the effects of perflubron, a radio-opaque material used for partial liquid ventilation which is a treatment different than that discussed. Of course, the interested reader may pursue the referenced articles for even more information.

Finally, medical directors of respiratory care centers and intensive care units could use these cases to strengthen interdisciplinary cooperation because they provide a starting point for physicians, nurses, and respiratory therapists to discuss common medical conditions. I also think the authors should be congratulated for bringing this popular, affordable, and effective form of learning to respiratory care practitioners.

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A Reappraisal of Mouth-to-Mouth Ventilation during Bystander-Initiated Cardiopulmonary Resuscitation

A Statement for Healthcare Professionals from the Ventilation Working Group of the Basic Life Support and Pediatric Life Support Subcommittees, American Heart Association

Lance B Becker MD, Chair; Robert A Berg MD; Paul E Pepe MD MPH; Ahamed H Idris MD; Thomas P Aufderheide MD; Thomas A Barnes EdD RRT; Samuel J Stratton MD; and Nisha C Chandra MD

Cardiopulmonary resuscitation (CPR) performed by bystanders clearly improves survival of victims of out-of-hospital cardiac arrest and other life-threatening conditions such as drowning and respiratory arrest.[1,2] However, despite three decades of promulgation, CPR is not performed for the majority of victims who require lifesaving care.[3-6] Studies have identified reticence to perform mouth-to-mouth ventilation as a significant barrier to more frequent performance of bystander CPR.[1,7-13] In addition to acting as a barrier to initiation of CPR, the mouth-to-mouth ventilation component of CPR may have other adverse effects, such as promoting gastric insufflation[14-17] or decreasing the percentage of time allocated to effective chest compression.[18-20]

Because early CPR plays a central role in saving lives, the Ventilation Working Group of the Basic Life Support (BLS) and Pediatric Life Support Subcommittees of the AHA (American Heart Association) Emergency Cardiovascular Care (ECC) Committee reviewed the scientific evidence on mouth-to-mouth ventilation. The ECC Committee and its subcommittees prepare guidelines and recommendations for providing emergency cardiovascular care and cardiopulmonary resuscitation in the United States and will formally review and publish updated guidelines in the year 2000. Although this report represents a focused analysis and serves as a consensus statement regarding the role of mouth-to-mouth ventilation during CPR, it is not intended to change any current AHA recommendations or guidelines for performance of CPR. The specific purpose of this report is to review the historical rationale for providing mouth-to-mouth ventilation during CPR and to critically analyze, using the available scientific literature, the following questions: (1) Does assisted ventilation during CPR result in improved physiological status or survival? (2) Are there adverse effects that result from inclusion of mouth-to-mouth ventilation in basic CPR techniques? (3) Could mouth-to-mouth ventilation be deferred or delayed in certain cases of bystander CPR? Finally, new recommendations are presented, particularly regarding the ethics of human clinical trials on the performance of CPR techniques without mouth-to-mouth ventilation.

Historical Rationale for Mouth-to-Mouth Ventilation

Historical Studies of Ventilation

The importance of ventilation during resuscitation has been accepted for centuries, with the earliest descriptions of assisted ventilation documented in stories of the prophets Elijah and Elisha in the Bible. Examples of mouth-to-mouth ventilation

"A Reappraisal of Mouth-to-Mouth Ventilation during Bystander-Initiated Cardiopulmonary Resuscitation" was approved by the American Heart Association Science Advisory and Coordinating Committee in July 1997.

This article also appears in *Circulation* (September 16, 1997), *Annals of Emergency Medicine* (November 1997), and *Resuscitation*.

A single reprint is available after September 30, 1997 by calling 800-242-8721 (U.S. only) or by writing the American Heart Association, Public Information, 7272 Greenville Avenue, Dallas TX 75231-4596. Ask for reprint No. 71-0118. To purchase additional reprints: up to 999 copies, call 800-611-6083 (U.S. only) or fax 413-665-2671; 1000 or more copies, call 214-706-1466, fax 214-691-6342, or e-mail pubauth@amhrt.org. To make photocopies for personal or educational use, call the Copyright Clearance Center, 508-750-8400.

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and the suggestion to teach it widely to the public also exist in a description of the resuscitation of a miner overcome by smoke in 1744.[21] Experiments conducted in 1796 demonstrated that expired air was "safe for breathing."[22,23] Over the next two centuries various artificial ventilatory techniques were tested during resuscitation, including the use of bellows, rolling the victim over a barrel, or positioning the victim on a trotting horse. Perhaps the most commonly used and effective artificial ventilation techniques were those that were popular both in the United States and Europe in the early 1900s. These included several manual methods of ventilation (eg, Schäfer's prone-pressure method and the Holger-Nielsen method)[24] (Fig. 1). With many of these techniques the patient was placed in a prone position (perhaps favoring an open airway); pressure was then rhythmically applied to and released from the posterior chest and back while the patient's arms were lifted cyclically. By 1953 at least 105 published articles described methods for artificial resuscitation of adults; 12 articles discussed resuscitation of children.[25] During the first half of the 20th century these so-called "manual" techniques were endorsed and taught by the Red Cross and commonly used by lifeguards, the military, and Boy Scouts.

In a landmark study in the 1950s, Safar and colleagues[26] demonstrated that the tongue and soft palate commonly obstructed the upper airway in unconscious persons. They further demonstrated that the manual ventilation techniques developed in the 1900s were relatively ineffective in the presence of such obstruction. The chin-lift and the jaw-thrust techniques for opening the airway of the supine patient were developed to remove obstructions and maintain airway patency.[27,28] Safar and Elam[29,30] then demonstrated a practical advantage of expired breath ventilation over previous manual methods with the patient lying supine. Specifically they compared tidal volumes generated during mouth-to-mouth (or mouth-to-airway) ventilation with those generated using the older manual techniques in paralyzed and anesthetized adults with normal circulation. Although the Holger-Nielsen method (one of the most effective manual techniques) generated >340 mL/min tidal volume in five of six patients, it was still less effective than mouth-to-mouth ventilation (Fig. 1). On the basis of these and similar confirmatory studies, mouth-to-mouth ventilation became the therapy of choice for out-of-hospital respiratory arrest by the 1960s.[31,32]

While these studies on ventilatory techniques were being conducted, other laboratories sought a practical method of providing circulatory support during cardiac arrest. Because external chest compression could provide partial circulatory support, the mouth-to-mouth ventilation technique was added to chest compression to create modern CPR. The "ABC" sequence of resuscitation—*A*irway patency, *B*reathing (with mouth-to-mouth ventilation), and *C*irculation (chest compression)—emerged as a practical and empirical means of CPR (Fig. 2).[33,34] Because most adult cardiac arrest victims become apneic or generate abnormally diminished respiratory efforts, it has long been assumed that mouth-to-mouth ventilation should be an integral component of CPR. On the basis of the physiological principle of rapidly restoring "normal" breathing and circulation and the subsequent success of CPR in the clinical setting, a sequence of mouth-to-mouth ventilation at a rate of 10 to 12 breaths per minute for adults, with each breath followed by five chest compressions (two rescuers), was recommended by consensus and adopted by the AHA.[1,35]

Effectiveness of Traditional Techniques of Cardiopulmonary Resuscitation

Over the past 25 years many studies have reinforced the empirical practice of the ABC sequence for CPR by confirming the effectiveness of bystander-initiated CPR.[2,4,5,36-39] The outcome of most cases of adult cardiac arrest depends primarily on the time interval from cardiac arrest until defibrillation.[5,40-44] Therefore, rapid provision of defibrillation is considered the most important determinant of successful outcome.[1,40,41,43,44] However, traditional CPR extends the time available for successful defibrillation and resuscitation.[43,44] Specifically investigations of "adult" type cardiac arrest in laboratory animals indicate that (1) maintenance of adequate coronary perfusion pressure and resultant myocardial blood flow during chest compression are critical for optimal survival, and (2) the window for successful bridging until defibrillation is 10 to 18 minutes.[45-53] Clinical studies similarly indicate that success of CPR improves when (1) the cardiac arrest is witnessed, (2) immediate bystander CPR is provided, (3) adequate coronary perfusion pressures are obtained during CPR, (4) the initial rhythm is ventricular fibrillation, and (5) early defibrillation is provided.[5,36,40-44,54-61] Data from both animals and humans concur: time is of the essence. Traditional bystander-initiated CPR can improve survival when it is started within 4 to 6 minutes from the time of collapse and followed with advanced cardiac life support within 10 to 12 minutes of collapse.[43,44] Nevertheless, although these studies have reinforced the value of the ABC technique, few studies have focused on the relative efficacy of mouth-to-mouth ventilation or chest compression alone.

Does Assisted Ventilation Improve Outcome of Cardiopulmonary Resuscitation?

Respiratory Physiology during Cardiopulmonary Resuscitation

Pulmonary function involves both oxygenation (diffusion of O_2 into the bloodstream) and ventilation (movement of a volume of gas in and out of the lungs, resulting in removal of CO_2). Although the roles of ventilation and oxygenation are intertwined during breathing, each has important, separate considerations in patient management. Inadequate oxy-

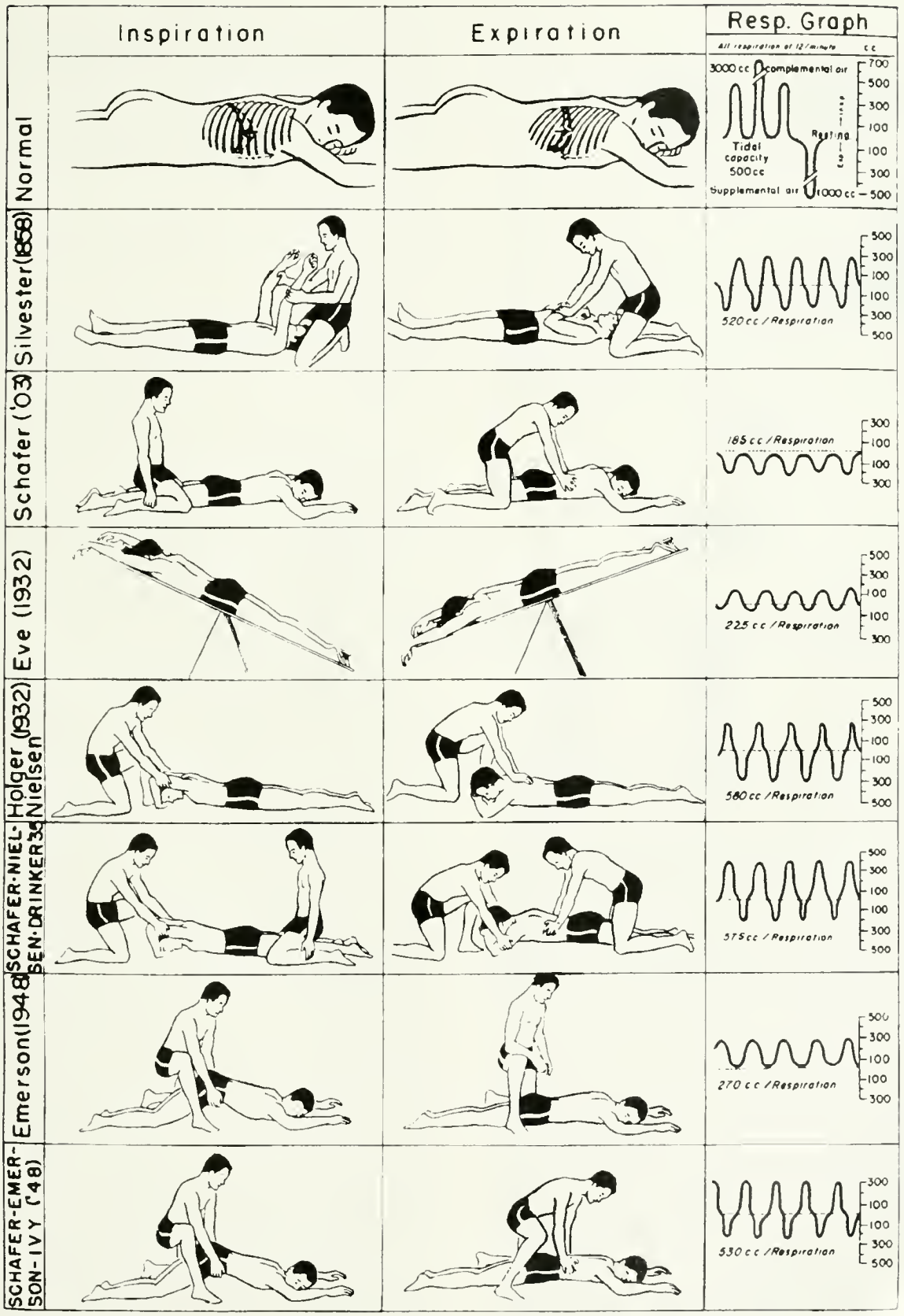

Fig. 1. Manual techniques of artificial respiration. There was intense interest in artificial ventilation methods during the first half of the 20th century. From Gordon et al.[24]

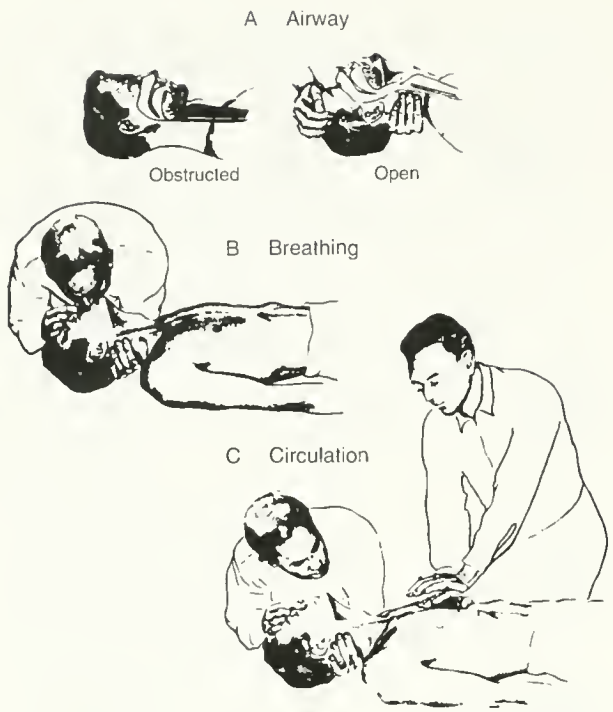

Fig. 2. The ABCs of resuscitation. Modern CPR was a combination of ventilatory support with circulatory support. From the Cardiopulmonary Resuscitation Committee.[34] Copyright 1966 American Medical Association.

genation of the blood (ie, hypoxemia) can occur during CPR, due to hypoventilation (high arteriolar P_{CO_2}), pulmonary alveolar shunting, and ventilation-perfusion mismatch. These physiological abnormalities may be the result of lung deflation, frank atelectasis, pulmonary edema, airway obstruction, or pulmonary aspiration of gastric contents before or during CPR. Supplemental oxygen administration and recruitment of lung volume through reinflation are the mainstays of therapy for hypoxemia in these circumstances. Endotracheal intubation is often necessary for reinflation, particularly in view of diminished lung compliance after several minutes of apnea and chest compression.[62-65]

Traditionally the ventilatory goals of CPR training techniques have stressed empirically that minute ventilation be more or less normal.[34] However, current techniques for mouth-to-mouth ventilation were developed in paralyzed anesthetized subjects with normal circulation, conditions *not* typically present during CPR scenarios. Both oxygenation and ventilation requirements may be altered during circulatory arrest because cardiac output and pulmonary blood flow generated even during CPR that is well performed are far lower than blood flow during spontaneous circulation. With low blood flow, end-organ tissues become ischemic, extract a higher percentage of O_2, and accumulate higher levels of CO_2 ("tissue acidosis"),[66,67] but arterial blood gases may not reflect these tissue conditions.[68] As a result, the goals of oxygenation and ventilation during CPR have not been established, and interpretation of arterial blood gases is not clear.[68,69] Therefore, it is difficult to evaluate current oxygenation/ventilation techniques. Collectively there is little evidence that oxygenation and ventilation need to be "normalized" during fibrillatory cardiac arrest because the primary disorder is due to low blood flow, not respiratory insufficiency.

Sources of Ventilation during Cardiopulmonary Resuscitation

Although active mouth-to-mouth ventilation has been stressed in traditional CPR training, it is also important to consider that many other sources of gas movement can contribute to oxygenation and ventilation in patients receiving CPR. Indeed, there are several potentially important sources of ventilation during cardiac arrest with attempted resuscitation including compression-induced ventilation and gasping respiration. Compression-induced ventilation commonly results when gas is expelled from the lungs and is "passively inhaled" following elastic recoil of the chest wall during the relaxation phase.[70-76] In multiple animal studies, compression-induced ventilation alone has proved quite substantial when measured.[71,74,75-77] However, measured minute ventilation and arterial oxygenation decrease after 4 to 10 minutes of CPR with or without assisted ventilation, possibly because of progressive chest compression–induced atelectasis and thoracic deformity.[71,78] Thus, with longer periods of cardiac arrest, ventilation may become more important. This is supported by animal studies in which chest compression periods were more prolonged, demonstrating that chest compression with assisted ventilation and adequate lung inflation result in better oxygenation compared with chest compression without assisted ventilation.[71,74] In addition to compression-induced ventilation, spontaneous respiration, usually in the form of agonal or gasping breathing, commonly occurs during cardiac arrest in both animals and humans, further contributing to total ventilation.[75,76,78,79] Several recent investigations in animals have specifically established that spontaneous gasping occurs early during CPR and is associated with a better outcome.[74,75,76,78,79] Spontaneous gasping may simply reflect improved oxygen delivery to the medulla during CPR, or it may reflect a shorter cardiac arrest interval. However, the mechanics of gasping may also improve the effectiveness of CPR because of (1) improved venous return during the negative-pressure inspiratory efforts, (2) augmentation of cardiac output due to increased intrathoracic pressure during the expiratory phase of gasping, and (3) improved pulmonary gas exchange due to both increased airflow and the more physiological "pulling open" of those dependent lung zones subject to deflation. In one study of swine, spontaneous gasping contributed approximately half of the measured minute ventilation during chest-compression-only CPR, compared with <10% during chest compression plus mechanical ventilation.[74]

Therefore, in human and animal studies some component of compression-induced ventilation and gasping respiration—which by themselves may be important sources of gas exchange—is present unless specifically prevented. In turn, studies reporting CPR performed "without ventilation" may not be strictly accurate; the authors more likely mean "without mouth-to-mouth ventilation" or "without assisted ventilation." Although not necessarily measured or reported, the contributions of compression-induced ventilation and gasping respiration may still be substantial in the absence of mouth-to-mouth ventilation. In contrast to the original studies of mouth-to-mouth ventilation in which anesthetic and paralytic agents were administered to subjects with normal circulation, these components of ventilation during CPR may be sufficient for a short time to produce survival when coupled with effective chest compression.

Experimental Studies of Assisted Ventilation

With the recognition that ventilatory requirements during cardiac arrest are unclear and acknowledging that compression-induced ventilation and gasping respiration may be important sources of gas movement, the requirement for and timing of mouth-to-mouth ventilation can be questioned. A canine study on the effects of mechanically assisted breathing (as an approximation of human mouth-to-mouth ventilation) was performed in 1983 by Meursing et al.[80] In this study CPR was delayed for 5 minutes following sudden circulatory arrest, and no significant fall in arterial P_{O_2} or rise in P_{CO_2} was observed. Chest compression was then initiated, but assisted ventilation was withheld for 2 minutes. No significant fall in arterial P_{O_2} or rise in P_{CO_2} was demonstrated over the next 30 seconds. This study, reported only in an abstract, was a key consideration in CPR guidelines developed in the Netherlands and reflects a lack of conviction regarding the importance of immediate ventilation. Instead of using the ABC sequence, the Netherlands approach to sudden witnessed arrests is "CAB" (*C*irculation, *A*irway, *B*reathing). Rescue breathing is delayed (several seconds and, infrequently, several minutes) to enable prompt provision of chest compression. Survival outcomes with CAB appear to be similar to, if not better than, those reported with ABC CPR.[81]

Many laboratory studies support this concept. Berg and colleagues[82] demonstrated that fibrillatory cardiac arrest in swine provided with chest compression alone for 9.5 minutes maintained an arterial pH of 7.33 and arterial P_{CO_2} of 48 mm Hg. In a nonintubated canine cardiac arrest model, Chandra et al[70] demonstrated that arterial oxygen saturation could be maintained above 90% with a measured minute ventilation of 5 L/min being generated during the fourth minute of chest compression alone without any assisted ventilation.

The need for assisted ventilation during CPR for fibrillatory arrest has been evaluated in four swine studies with long-term survival. Each reported nearly identical 24-hour survival and neurological outcome with chest compression alone versus chest compression plus assisted ventilation.[74,75,76,82] Fibrillatory cardiac arrest intervals varied from 30 seconds to 5 minutes, and CPR was provided for 8 to 12 minutes. In a more recent study swine underwent a 5-minute fibrillatory cardiac arrest interval, followed by 8 minutes of (1) chest compression alone, (2) chest compression plus assisted ventilation, or (3) no CPR at all. Assisted ventilation (at 15 mL/kg tidal volume) was provided with 17% oxygen and 4% carbon dioxide to better simulate the exhaled gas delivered during human mouth-to-mouth ventilation. The results showed that without CPR there were no survivors. Both the chest-compression-alone group and the chest-compression-plus-assisted-ventilation group had significantly better survival than the no-CPR group. However, whether or not assisted ventilation was performed made no detectable difference on either return of spontaneous circulation or 24-hour survival rates (Fig. 3).[76]

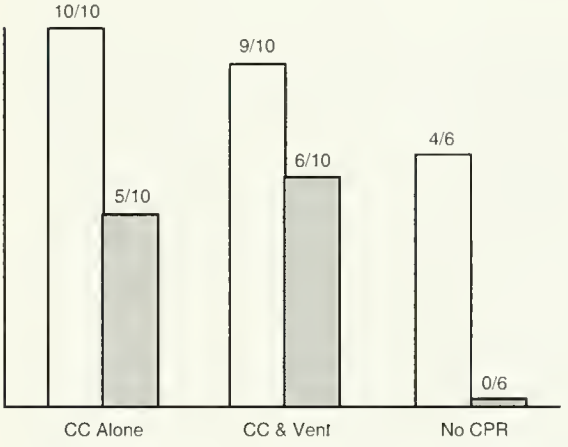

Fig. 3. Survival with chest compression with and without assisted ventilation; return of spontaneous circulation = □; 24-hour survival = ▭. Five minutes after ventricular fibrillation, swine were treated for 8 additional minutes with simulated mouth-to-mouth exhaled gas ventilation (17% O_2 and 4% CO_2) plus chest compression (CC & vent), chest compression alone (CC alone), or no CPR. No differences could be detected between groups with or without ventilation if chest compression was provided. Both CPR groups tended toward improved survival compared with no CPR. Data from Berg et al.[76]

Idris and colleagues[83] have demonstrated that with prolonged arrest intervals beyond 6 minutes, supplemental oxygenation and assisted ventilation should still be considered critical determinants of CPR success. In one study, swine underwent 6 minutes of untreated ventricular fibrillation, followed by 10 minutes of chest compression plus assisted ventilation (12 mL/kg) with 85% oxygen versus chest compression without assisted ventilation. The nonventilated animals were paralyzed to prevent gasping and its effect on total ventilation. Return of spontaneous circulation was achieved in 9 of 12 (75%) ventilated

animals versus only 1 of 12 (8%, $p < 0.002$) nonventilated animals. However, with arrest intervals of less than 6 minutes, these differences were not apparent. The investigators further demonstrated that assisted ventilation with either hypoxic or hypercarbic gas admixtures during CPR resulted in lower resuscitation rates compared with assisted ventilation with 85% oxygen.[84]

In summary, the published experimental data on animals collectively suggest that assisted ventilation may not be critical in the early minutes after onset of sudden fibrillatory cardiac arrest if adequate chest compression is provided. However, after relatively longer intervals of untreated fibrillatory cardiac arrest, some form of ventilatory support is likely to become critical for successful resuscitation outcomes. Whether mouth-to-mouth ventilation as the form of ventilatory support is helpful during even prolonged fibrillatory cardiac arrest remains unclear.

Clinical Studies of Mouth-to-Mouth Ventilation

Are the results obtained from animal studies applicable to CPR in human beings? Upper airway anatomy of animals differs from that of human beings; thus, upper airway obstruction during cardiac arrest may differ among species. Many animal species demonstrate frequent and prolonged gasping. Laboratory animals also do not have coronary artery disease. Unlike animal studies, the adequacy of oxygenation and ventilation during chest-compression-only CPR (ie, without mouth-to-mouth ventilation) has not yet been demonstrated in human beings receiving CPR.

Nevertheless, the available human data to date are consistent with findings in animals.[38,75,85,86] For example, Weil et al[86] demonstrated that during the first few minutes of CPR in humans, arterial pH, P_{aCO_2}, and bicarbonate change little from prearrest values. In addition, agonal respiration or gasping has also been documented in 40% of 445 out-of-hospital cardiac arrest victims and 55% of those victims with witnessed arrests.[85] Furthermore, as in animal studies, agonal respiration or gasping was associated with improved survival. Survival was 27% when gasping was present, compared with 9% when it was not. It is uncertain if the gasping was a marker for better central nervous system perfusion or shorter arrest intervals or if the agonal breaths themselves contributed to improved outcome.

Notably, recent investigations in humans with the active compression-decompression CPR device (plunger type) demonstrated that excellent minute ventilation (>6 L/min) was maintained in four cardiac arrest victims without assisted ventilation or intubation of the airway.[87] New investigations are still necessary to determine whether standard chest compression consistently results in adequate gas exchange for successful resuscitation of human victims of cardiac arrest.

Although physiological studies are informative, long-term survival in the clinical setting is the major therapeutic end point of CPR. The Belgian Cerebral Resuscitation Group[38,39] prospectively evaluated 3053 out-of-hospital arrests. Physicians on the ambulances evaluated the quality of bystander CPR for compression and ventilation. Long-term survival of those treated with good-quality chest compression alone and those treated with good-quality chest compression plus mouth-to-mouth ventilation was comparable (15% and 16%, respectively) (Fig. 4). Survival when either of these techniques was used was significantly superior to survival without any CPR (6%, $p < 0.001$). The data confirm that bystander CPR can be lifesaving but also suggest that mouth-to-mouth ventilation may not be necessary for survival of cardiac arrest, at least during the immediate moments after arrest. The authors of the study cautioned that conclusions drawn from these observations should be limited to adult patients with witnessed fibrillatory cardiac arrest.

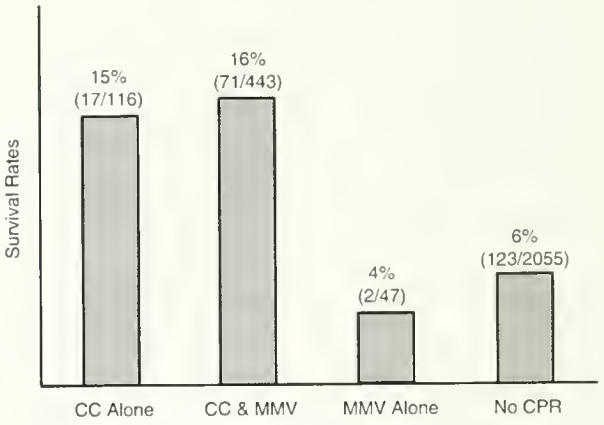

Fig. 4. Survival rates in comparison of good quality chest-compression-only CPR. The quality of bystander CPR was assessed by physician observers on ambulances. Comparisons of long-term survival rates are demonstrated after good quality chest-compression-only bystander CPR (CC alone), good quality chest-compression-plus-mouth-to-mouth-ventilation bystander CPR (CC & MMV), good quality mouth-to-mouth-ventilation-only CPR (MMV alone), and no bystander CPR. Outcome after chest-compression-only bystander CPR or chest-compression-plus-mouth-to-mouth-ventilation bystander CPR did not differ. Survival with either of these techniques was superior to survival with no bystander CPR ($p < 0.001$). Data derived from two studies of the Belgian Cerebral Resuscitation Study Group.[38,39]

Lengthier periods of arrest may require earlier ventilatory support. The observation that some ventilatory interventions are helpful after prolonged fibrillatory cardiac arrest may indicate an oxygenation or lung inflation requirement as much as a need for ventilation (CO_2 elimination). It seems probable that progressive lung deflation and airway closure occurs during chest compression without gasping or mouth-to-mouth ventilation. Such lung deflation will lead to increased pulmonary shunting and progressive hypoxemia. Reversal of lung

deflation with an occasional lung inflation may be the critical pulmonary intervention to prevent hypoxia. If so, it may still be unnecessary to "normalize" respiratory rates in fibrillatory cardiac arrest until spontaneous circulation returns. Future studies should therefore attempt to delineate the critical timing, tidal volumes, and rates for optimal resuscitation.

Are There Adverse Effects of Mouth-to-Mouth Ventilation?

Respiratory Effects

When no endotracheal tube is in place, assisted ventilation maneuvers often are associated with gastric insufflation and pulmonary aspiration of gastric contents, which in turn may cause adult respiratory distress syndrome, pneumonitis, and possible death.[63] Some studies suggest a 10% to 35% incidence of pulmonary aspiration of gastric contents associated with CPR. During mouth-to-mouth ventilation, positive pressure in the oropharynx forces air into the lungs. Gas, however, flows down the path of least resistance, which may be either the trachea and lungs or the esophagus and stomach. Gastric insufflation is more apt to occur when (1) pulmonary compliance decreases (eg, with CPR, pulmonary edema, atelectasis, obesity, and the supine position), (2) airway resistance increases (eg, obstructive pulmonary disease), or (3) lower esophageal sphincter tone decreases.[14,15,88,89]

Lower esophageal sphincter tone usually prevents regurgitation of gastric contents and provides resistance to gastric air flow during positive pressure ventilation. The normal esophageal sphincter opening pressure is about 20 to 25 cm H_2O.[90,91] However, this energy-dependent muscular tone decreases rather quickly after circulatory arrest. In a swine model of CPR, mean esophageal sphincter opening pressure decreased from 20.6 cm H_2O before cardiac arrest to 5.6 cm H_2O after 5 minutes of cardiac arrest.[92] In anesthetized patients with adequate circulation, gastric insufflation commonly occurs with bag-valve mask ventilation unless cricoid pressure is provided.[93] During cardiac arrest and CPR, pulmonary compliance decreases, increased inspiratory pressures may be needed to inflate the lung, and lower esophageal sphincter tone may decrease, all factors that increase gastric insufflation. Regurgitation was noted to occur primarily after the stomach was insufflated with air.[16] Not surprisingly, in one series gastric insufflation and pulmonary aspiration were documented in nearly half of cardiac arrest victims after CPR with mouth-to-mouth ventilation.[17]

Another consideration is whether there are important differences between exhaled gas and ambient air. While room air has 21% O_2 and 0.03% CO_2, exhaled gas was observed to contain a mean O_2 concentration of 16.6% to 17.8% and a mean CO_2 concentration of 3.5% to 4.1% during one- and two-rescuer CPR.[19] Thus, as provided during mouth-to-mouth ventilation, expired gas is slightly hypoxic and contains considerably more CO_2 than ambient air ventilation achieved with gasping and compression-induced ventilation alone.[94]

Although expired gas rescue breathing is safe and may be lifesaving for patients with respiratory arrests, the hypercarbia may have adverse cardiovascular effects when compared with ambient air ventilation during circulatory arrest. In one study of isolated hypercarbia, animals ventilated (12 mL/kg) with 95% O_2 and 5% CO_2 did as poorly as animals receiving no assisted ventilation at all during CPR.[84] Another investigation showed that swine ventilated with room air during 6 minutes of CPR had a rate of successful resuscitation (83%) twice that of animals ventilated with simulated exhaled gas ventilation when both groups received similar tidal volumes (38%, $p < 0.01$).[95] Consistent with animal studies are cellular studies that demonstrate modest increases in concentration of CO_2 can inhibit the rate and force of cardiac contraction, suggesting that elevated CO_2 has a direct cardiodepressive effect.[96,97]

Circulatory Effects

Obviously a single rescuer performing CPR on an adult or child cannot provide chest compression and mouth-to-mouth ventilation simultaneously. Thus, it follows that with more time spent attempting ventilation, less time will likely be allocated to chest compression and vice versa. As noted, successful resuscitation has been highly correlated with the timing and degree of restored myocardial blood flow and coronary perfusion pressure, which are in turn dependent on the effective provision of chest compression of a sufficient rate and depth.[98-101] Therefore, time spent attempting ventilation may take away valuable coronary perfusion. In support of this concept are recent studies that suggest that when rescuers attempt ventilation using current AHA recommendations, the compression rate and depth become inadequate.[102] Current AHA guidelines for adult CPR recommend a chest compression rate of 80 to 100 per minute and a respiratory rate of approximately 12 breaths per minute, with compression/ventilation ratios of 15:2 with one rescuer and 5:1 with two rescuers. However, achieving these recommended guidelines in the real world has been demonstrated as problematic for both one- and two-rescuer adult CPR with mouth-to-mouth ventilation.[18-20,101-103] One study of in-hospital two-rescuer CPR found that only 2 of 12 rescuers gave 80 compressions or more per minute,[103] whereas another investigation of simulated two-rescuer CPR on a manikin found that compression rates averaged 75 per minute and that the depth of compression was inadequate in 14% to 22%.[101] These inadequacies of chest compression observed in two-rescuer CPR appear to be even worse in studies of one-rescuer CPR.[18-20] In a study of healthcare professionals performing one-rescuer CPR on a manikin, only 15% achieved a rate of 80 compressions per minute despite continuous coaching.[19] Further investigation confirmed that even immediately after successful completion of a basic CPR course, compression rates were particularly inadequate; on average,

only 56 compressions per minute were provided by the 129 medical students studied.[20]

These data suggest that the competition between time for ventilation and time for compression during one-rescuer CPR is a "zero-sum" game; time spent on ventilation takes precious time away from chest compression and support of myocardial blood flow. It is surprising that this aspect of CPR as practiced in the real world (ie, cycle time spent on ventilation versus cycle time spent on compression) has not been studied. It is worrisome that multiple studies have demonstrated survival rates to be consistently correlated with coronary perfusion pressure whereas no studies of fibrillatory arrest have shown improved rates of survival with early ventilation. Future studies need to take these real-world factors into account and not assume that performance of CPR is in complete adherence with AHA guidelines (which appears to be infrequently achieved).

Does Mouth-to-Mouth Ventilation Inhibit Performance of Bystander Cardiopulmonary Resuscitation?

Despite widespread acknowledgment of its value and efficacy, CPR is not performed by bystanders in the majority of cases for which it is indicated. Furthermore, several recent studies have documented a lower overall frequency of bystander CPR performance compared with earlier investigations.[3] Although this latter finding may have several possible explanations (including the failure of the medical community and public health officials to effectively teach the public the skills of CPR), the perceived risk of disease transmission during CPR, even by healthcare workers, has become increasingly suspect as a major factor.

The actual risks of disease transmission during mouth-to-mouth ventilation are quite small. There are isolated reports of possible transmission of *Helibacter pylori*,[104] *Mycobacterium tuberculosis*,[105] meningococcus,[106] herpes simplex,[107-109] shigella,[110] streptococcus,[111] and salmonella.[112] No reports on transmission of HIV can be found. Nevertheless, despite the remote chances of its occurring, fears regarding disease transmission are common in the current era of universal precautions. Indeed, not only laypersons but physicians, nurses, and even BLS instructors are extremely reluctant to perform mouth-to-mouth ventilation.[7-9,12,113] The most commonly stated reason for not performing mouth-to-mouth ventilation is fear of contracting AIDS.[13] In one survey, only 15% of 975 respondents reported a willingness to perform chest compression with mouth-to-mouth ventilation on a stranger, whereas 68% would "definitely" perform chest compression alone if it was offered as an effective alternative CPR technique.[12]

Fear of disease transmission may not be the only reason that mouth-to-mouth ventilation inhibits bystanders from initiating CPR. When mouth-to-mouth ventilation is combined with chest compression, the CPR technique becomes a complex psychomotor task that can be difficult to teach, learn, remember, and perform.[82,114] Educational principles suggest that a simpler technique, such as chest compression without mouth-to-mouth ventilation, would be far easier to teach the public. If it were known that the use of chest compression alone was nearly as efficacious as when combined with mouth-to-mouth ventilation, potential rescuers might start chest-compression CPR faster and more frequently because it is easier to perform in an actual emergency. In addition, the greater ease of learning, retaining, and performing such a simple procedure could lead to more widespread performance of bystander CPR, thereby improving survival rates for victims of cardiac arrest.

Special Considerations: Implications for Future Guidelines

It is important to emphasize that this report makes no changes in current AHA CPR guidelines and to consider why no changes are warranted. To summarize, during fibrillatory cardiac arrest, mouth-to-mouth ventilation may provide a modest therapeutic advantage over chest compression alone, and it may have some deleterious effects. Both experimental and very limited clinical studies to date suggest that mouth-to-mouth ventilation may be deferred for several minutes in the patient with sudden fibrillatory arrest. No studies on mouth-to-mouth ventilation are yet available for asphyxial cardiac arrest. On the basis of this review, in the most applicable clinical scenario for delaying mouth-to-mouth ventilation, an adult (older than 40 years) suddenly collapses from ventricular fibrillation. The collapse is witnessed by a bystander who can immediately initiate chest compression. However, this is a limited subpopulation of cardiopulmonary arrests and is not applicable to many resuscitations, such as those conducted for children, victims of submersion, respiratory failure, and many other arrest types. In addition, the available data from laboratory animals also suggest that after several minutes of fibrillatory arrest some form of ventilation is helpful, presumably to reinflate collapsing gas exchange units and prevent profound hypoxia. Therefore, it is important for future studies to delineate the specific circumstances and time limits under which mouth-to-mouth ventilation might be deferred. Without these data, rational guidelines cannot be provided. Although the current data are insufficient to warrant a change in CPR guidelines and training, they are compelling enough to recommend additional experimental and human trials to better delineate what the exact role of mouth-to-mouth ventilation should be during CPR.

It is also important to note that the current discussion and available research focus only on the contribution of mouth-to-mouth ventilation in the setting of sudden adult fibrillatory cardiac arrest. The potential application of mouth-to-mouth ventilation may be much broader than merely responding to fibrillatory arrest. Intuitively, mouth-to-mouth ventilation seems clearly indicated in cases of cardiopul-

monary arrest associated with airway obstruction, water submersion, or preceding respiratory symptoms. Likewise, in children and young adults, respiratory compromise, not cardiac arrest, is the more common threat to life; thus, respiratory management should not be deferred. Submersion and respiratory problems are the typical precipitating causes of nontraumatic cardiac arrest in pediatric patients and young adults.[6,115,116] In addition, a child's pulse may be difficult to locate and measure.[117-120] These children may only be hypotensive (or even normotensive), and ventilatory support from mouth-to-mouth ventilation seems the highest priority under these circumstances.

Although the above recommendation on usefulness of mouth-to-mouth ventilation during asphyxial arrest for children with respiratory failure is logical, even this is not supported by data comparing the effectiveness of mouth-to-mouth ventilation with chest compression alone. A large amount of research is needed before the role and timing of mouth-to-mouth ventilation can be better clarified. As in adults, the relative importance of mouth-to-mouth ventilation and prompt defibrillation may be quite different among the many subgroups of cardiac arrest victims.[121] Unfortunately, as with adults, in the majority of pediatric out-of-hospital arrest patients, basic bystander CPR is not attempted. The working group continues to recommend prompt ventilatory support in the form of mouth-to-mouth ventilation for apneic, pulseless, unresponsive children.

Conclusions & Recommendations

Traditional bystander CPR with chest compression and mouth-to-mouth ventilation has been documented to save lives. Nevertheless, CPR is not being performed in the majority of cases for which it is needed. As a result, an alarming number of premature deaths occur each year in the United States alone due to failure to provide basic CPR.[1] Requiring that mouth-to-mouth ventilation be an essential component of one-rescuer CPR has added to the complexity of teaching, learning, remembering, and performing this procedure. Provision of mouth-to-mouth ventilation has important potential disadvantages, including gastric insufflation and less cycle time spent on effective chest compression. Above all, aesthetic and infectious disease concerns by the public and healthcare providers appear to be major barriers to provision of basic CPR.

Although it seems possible that mouth-to-mouth ventilation is not needed during the first minutes of sudden witnessed circulatory arrest with suspected ventricular fibrillation, it is likely that mouth-to-mouth ventilation should be the initial intervention for arrest of suspected respiratory etiology. If a delay in mouth-to-mouth ventilation is being considered, the overall net impact on the public for saving lives from all causes of arrest, not merely sudden fibrillatory circulatory arrest, must also be taken into account. Updated guidelines on CPR are published at regular intervals. It is the hope of the working group that additional data will be available for consideration at the international conferences on CPR planned for the year 2000.

The working group recommends that

- Current guidelines for performing mouth-to-mouth ventilation during CPR should not be changed at this time. Indeed, it should be noted that the current AHA guidelines state that if a person is unwilling to perform mouth-to-mouth ventilation, he or she should rapidly attempt resuscitation, omitting mouth-to-mouth ventilation.[1] *Clearly, provision of chest compression without mouth-to-mouth ventilation is far better than not attempting resuscitation at all.*[38]

- Additional research initiatives are required to expressly delineate the role of mouth-to-mouth ventilation in the management of sudden death. Such studies on ventilation should evaluate the timing, rate, and depth as well as conditions under which respiratory assistance should be used. In addition to determining optimal CPR in the laboratory, more research on real-world obstacles to learning, remembering, and actually performing CPR should be evaluated and incorporated into future recommendations.

- Clinical trials involving human subjects who receive chest compression with or without mouth-to-mouth ventilation are ethical and necessary to determine how to save the most lives with basic CPR. Institutional review boards and national agencies interested in public safety should be aware of the limitations of current data to adequately justify current practice guidelines. Well-designed studies that answer important questions on CPR should be encouraged.

- Organizations and agencies interested in public safety and reduction of premature death should allocate resources for research on these high-yield issues that will determine future CPR guidelines. Unlike many areas of medicine, the design and methods to find definitive answers to these questions are readily available and merely await financial support for completion.

REFERENCES

1. American Heart Association. Guidelines for cardiopulmonary resuscitation and emergency cardiac care. JAMA. 1992;268:2171-2183.
2. Cummins RO, Eisenberg MS. Prehospital cardiopulmonary resuscitation: is it effective? JAMA. 1985;253:2408-2412.
3. Lombardi G, Gallagher J, Gennis P. Outcome of out-of-hospital cardiac arrest in New York City: the Pre-Hospital Arrest Survival Evaluation (PHASE) Study. JAMA. 1994;271:678-683.
4. Eisenberg MS, Horwood BT, Cummins RO, Reynolds-Haertle R, Hearne TC. Cardiac arrest and resuscitation: a tale of 29 cities. Ann Emerg Med. 1990;19:179-186.
5. Becker LB, Ostrander MP, Barrett J, Kondos GJ. Outcome of CPR in a large metropolitan area: where are the survivors? Ann Emerg Med. 1991;20:355-361.

6. Schindler MB, Bohn D, Cox PN, McCrindle BW, Jarvis A, Edmonds J, Barker G. Outcome of out-of-hospital cardiac or respiratory arrest in children. N Engl J Med. 1996;335:1473-1479.
7. Brenner BE, Kauffman J. Reluctance of internists and medical nurses to perform mouth-to-mouth resuscitation. Arch Intern Med. 1993; 153:1763-1769.
8. Brenner B, Stark B, Kauffman J. The reluctance of house staff to perform mouth-to-mouth resuscitation in the inpatient setting: what are the considerations? Resuscitation. 1994;28:185-193.
9. Brenner B, Kauffman J, Sachter JJ. Comparison of the reluctance of house staff of metropolitan and suburban hospitals to perform mouth-to-mouth resuscitation. Resuscitation. 1996;32:5-12.
10. McCormack AP, Damon SK, Eisenberg MS. Disagreeable physical characteristics affecting bystander CPR. Ann Emerg Med. 1989;18: 283-285.
11. Michael AD, Forrester JS. Mouth-to-mouth ventilation: the dying art. Am J Emerg Med. 1992;10:156-161.
12. Locke CJ, Berg RA, Sanders AB, Davis MF, Milander MM, Kern KB, Ewy GA. Bystander cardiopulmonary resuscitation: concerns about mouth-to-mouth contact. Arch Intern Med. 1995;155:938-943.
13. Ornato JP, Hallagan LF, McMahan SB, Peeples EH, Rostafinski AG. Attitudes of BCLS instructors about mouth-to-mouth resuscitation during the AIDS epidemic. Ann Emerg Med. 1990;19:151-156.
14. Melker RJ, Banner MJ. Ventilation during CPR: two-rescuer standards reappraised. Ann Emerg Med. 1985;14:397-402.
15. Ruben H, Knudsen EJ, Carugti G. Gastric insufflation in relation to airway pressure. Acta Anaesthesiol Scand. 1961;5:107-114.
16. Ruben R, Ruben H. Artificial respiration: flow of water from the lung and the stomach. Lancet. 1962;1:780-781.
17. Ruben H. The immediate treatment of respiratory failure. Br J Anaesth. 1964;36:542-549.
18. Flesche CW, Noetges P, Schlack W, Zucker TP, Tarnow J. Quality of lay public cardiopulmonary resuscitation after standard first aid training courses. Resuscitation. 1994;28:S25. Abstract.
19. Wenzel V, Idris AH, Banner MJ, Fuerst RS, Tucker KJ. The composition of gas given by mouth-to-mouth ventilation during CPR. Chest. 1994;106:1806-1810.
20. Wenzel V, Lehmkuhl P, Kubilis PS, Idris AH, Pichlmayr I. Resuscitation skills of medical students six months after basic life support training. Resuscitation. 1997. In press.
21. Bartecchi CE. Cardiopulmonary resuscitation: an element of sophistication in the 18th century. Am Heart J. 1980;100:580-581.
22. DeBard ML. The history of cardiopulmonary resuscitation. Ann Emerg Med. 1980;9:273-275.
23. Hermreck AS. The history of cardiopulmonary resuscitation. Am J Surg. 1988;156:430-436.
24. Gordon A, Fainer D, Ivy A. Artificial respiration: a new method and a comparative study of different methods in adults. JAMA. 1950; 144:1455-1464.
25. Karpovich PV. Adventures in artificial respiration. New York: Association Press. 1953.
26. Safar P, Escarraga LA, Chang F. Upper airway obstruction in the unconscious patient. Appl Physiol. 1959;14:760-764.
27. Elam JO, Brown ES, Elder JJD. Artificial respiration by mouth-to-mask method: a study of the respiratory gas exchange of paralyzed patient ventilated by operator's expired air. N Engl J Med. 1954;250:749-754.
28. Guildner CW. Resuscitation—opening the airway: a comparative study of techniques for opening the airway obstructed by the tongue. J Am Coll Emerg Phys. 1976;5:588-590.
29. Safar P. Ventilatory efficacy of mouth to mouth artificial respiration: airway obstruction during manual and mouth to mouth artificial respiration. JAMA. 1958;167:335-341.
30. Safar P, Escarraga LA, Elam JO. Comparison of mouth-to-mouth and mouth-to-airway methods of artificial respiration with the chest-pressure arm-lift methods. N Engl J Med. 1958;258:671-677.
31. Safar P, Brown TC, Holtey WJ, Wilder RJ. Ventilation and circulation with closed-chest cardiac massage in man. JAMA. 1961;176: 574-576.
32. Dill DB. Symposium of mouth-to-mouth resuscitation (expired air inflation). Council on Medical Physics. JAMA. 1958;167:317-319.
33. Kouwenhoven WB, Jude JR, Knickerbocker GG. Closed-chest cardiac massage. JAMA. 1960;173:94-97.
34. Cardiopulmonary Resuscitation Committee on CPR of the Division of Medical Sciences, National Academy of Sciences–National Research Council. JAMA. 1966;198:138-145, 372-379.
35. Haffis LC, Kirimli B, Safar P. Ventilation-cardiac compression rates and ratios in cardiopulmonary resuscitation. Anesthesiology. 1967;28: 806-813.
36. Cummins RO, Eisenberg MS, Hallstrom AD, Litwin PE. Survival of out-of-hospital cardiac arrest with early initiation of cardiopulmonary resuscitation. Am J Emerg Med. 1985;3:114-119.
37. Bossaert L, Van Hoeyweghen R, Cerebral Resuscitation Study Group. Evaluation of cardiopulmonary resuscitation (CPR) techniques. Resuscitation. 1989;17:S199-S206.
38. Van Hoeyweghen RJ, Bossaert LL, Mullie A, Calle P, Martens P, Buylaert WA, Delooz H, Belgian Cerebral Resuscitation Study Group. Quality and efficiency of bystander CPR. Resuscitation. 1993;26:47-52.
39. Bossaert L, Vanhoeyweghen R, Cerebral Resuscitation Study Group. Bystanders cardiopulmonary resuscitation (CPR) in out-of-hospital cardiac arrest. Resuscitation. 1989;17(suppl):S55-S69.
40. Weisfeldt ML, Kerber RE, McGoldrick RP, Moss AJ, Nichol G, Ornato JP, Palmer DG, Riegel B, Smith SC Jr. American Heart Association report on the Public Access Defibrillation Conference, December 8-10, 1994. Automatic External Defibrillation Task Force. Circulation. 1995;92:2740-2747.
41. Weisfeldt ML, Kerber RE, McGoldrick RP, Moss AJ, Nichol G, Ornato JP, Palmer DG, Riegel B, Smith SC Jr. Public access defibrillation: a statement for healthcare professionals from the American Heart Association Task Force on Automatic External Defibrillation. Circulation. 1995;92:2763.
42. Eisenberg MS, Bergner L, Hallstrom A. Cardiac resuscitation in the community: importance of rapid provision and implications for program planning. JAMA. 1979;241:1905-1907.
43. Larsen MP, Eisenberg MS, Cummins RO, Hallstrom AP. Predicting survival from out-of-hospital cardiac arrest: a graphic model. Ann Emerg Med. 1993;22:1652-1658.
44. Valenzuela TD, Roe DJ, Kretin S, Spaite DW, Larsen MP. Estimating effectiveness of cardiac arrest interventions: a logistic regression survival model. Circulation. 1997. In press.
45. Redding JS, Pearson JW. Evaluation of drugs for cardiac resuscitation. Anesthesiology. 1963;24:203-207.
46. Pearson JW, Redding JS. Influence of peripheral vascular tone on cardiac resuscitation. Anesth Analg. 1965;44:746-752.
47. Ralston SH, Tacker WA, Showen L, Carter A, Babbs CF. Endotracheal versus intravenous epinephrine during electromechanical dissociation with CPR in dogs. Ann Emerg Med. 1985;14:1044-1048.
48. Michael JR, Guerci AD, Koehler RC, Shi AY, Tsitlik J, Chandra N, Niedermeyer E, Rogers MC, Traystman RJ, Weisfeldt ML. Mechanisms by which epinephrine augments cerebral and myocardial perfusion during cardiopulmonary resuscitation in dogs. Circulation. 1984;69:822-835.
49. Sanders AB, Ewy GA, Taft TV. Prognostic and therapeutic importance of the aortic diastolic pressure in resuscitation from cardiac arrest. Crit Care Med. 1984;12:871-873.
50. Sanders AB, Kern KB, Atlas M, Bragg S, Ewy GA. Importance of the duration of inadequate coronary perfusion pressure on resuscitation from cardiac arrest. J Am Coll Cardiol. 1985;6:113-118.
51. Sanders AB, Kern KB, Bragg S, Ewy GA. Neurologic benefits from the use of early cardiopulmonary resuscitation. Ann Emerg Med. 1987;16:142-146.

52. Kern KB, Ewy GA, Voorhees WD, Babbs CF, Tacker WA. Myocardial perfusion pressure: a predictor of 24-hour survival during prolonged cardiac arrest in dogs. Resuscitation. 1988;16:241-250.
53. Berg RA, Otto CW, Kern KB, Sanders AB, Hilwig RW, Hansen KK, Ewy GA. High-dose epinephrine results in greater early mortality after resuscitation from prolonged cardiac arrest in pigs: a prospective randomized study. Crit Care Med. 1994;22:282-290.
54. Paradis NA, Martin GB, Rivers EP, Goetting MG, Appleton TJ, Feingold M, Nowak RM. Coronary perfusion pressure and return of spontaneous circulation in human cardiopulmonary resuscitation. JAMA. 1990;263:1106-1113.
55. Eisenberg MS, Copass MK, Hallstrom AP, Blake B, Bergner L, Short FA, Cobb LA. Treatment of out-of-hospital cardiac arrests with rapid defibrillation by emergency medical technicians. N Engl J Med. 1980;302:1379-1383.
56. Adgey AA, Scott ME, Allen JD, Nelson PG, Geddes JS, Zaidi SA. Management of ventricular fibrillation outside hospital. Lancet. 1969;1:1169-1171.
57. Weaver WD, Copass MK, Bufi D, Ray R, Hallstrom AP, Cobb LA. Improved neurologic recovery and survival after early defibrillation. Circulation. 1984;69:943-948.
58. Weaver WD, Cobb LA, Hallstrom AP, Fahrenbruch C, Copass MK, Ray R. Factors influencing survival after out-of-hospital cardiac arrest. J Am Coll Cardiol. 1986;7:752-757.
59. Copley DP, Mantle JA, Rogers WJ, Russell RO Jr, Rackley CE. Improved outcome for prehospital cardiopulmonary collapse with resuscitation by bystanders. Circulation. 1977;56:901-905.
60. Becker LB, Han BH, Meyer PM, Wright FA, Rhodes KV, Smith DW, Barrett J, CPR Chicago Project. Racial differences in the incidence of cardiac arrest and subsequent survival. N Engl J Med. 1993;329:600-606.
61. Kyriacou DN, Arcinue EL, Peek C, Kraus JF. Effect of immediate resuscitation on children with submersion injury. Pediatrics. 1994;94:137-142.
62. Fuerst R, Idris A, Banner M, Wenzel V, Orban D. Changes in respiratory system compliance during cardiopulmonary arrest with and without closed chest compressions. Ann Emerg Med. 1993;22:931.
63. Pepe PE. Acute respiratory insufficiency. In: Hardwood-Nuss AL, Linden CH, Luten RC, Shepherd SM, Wolfson AB, eds. The Clinical Practice of Emergency Medicine. Philadelphia, Pa: JB Lippincott Co: 1996:636-640.
64. Pepe PE, Zachariah BS, Chandra NC. Invasive airway techniques in resuscitation. Ann Emerg Med. 1993;22(Pt 2):393-403.
65. Pepe PE, Copass MK, Joyce TH. Prehospital endotracheal intubation: rationale for training emergency medical personnel. Ann Emerg Med. 1985;14:1085-1092.
66. Johnson BA, Weil MH, Tang W, Noc M, McKee D, McCandless D. Mechanism of myocardial hypercarbic acidosis during cardiac arrest. Am J Physiol. 1995;78:1579-1584.
67. Kette F, Weil MH, Gazmuri RJ, Bisera J, Rackow ER. Intramyocardial hypercarbic acidosis during cardiac arrest and resuscitation. Crit Care Med. 1993;21:901-906.
68. Tucker KJ, Idris AH, Wenzel V, Orban DJ. Changes in arterial and mixed venous blood gases during untreated ventricular fibrillation and cardiopulmonary resuscitation. Resuscitation. 1994;28:137-141.
69. Idris AH, Staples ED, O'Brien DJ, Melker RJ, Rush WJ, Del Duca KD, Falk JL. Effect of ventilation on acid-base balance and oxygenation in low blood-flow states. Crit Care Med. 1994;22:1827-1834.
70. Chandra NC, Gruben KG, Tsitlik JE, Brower R, Guerci AD, Halperin HH, Weisfeldt ML, Permutt S. Observations of ventilation during resuscitation in a canine model. Circulation. 1994;90:3070-3075.
71. Idris AH, Banner MJ, Wenzel V, Fuerst RS, Becker LB, Melker RJ. Ventilation caused by external chest compression is unable to sustain effective gas exchange during CPR: a comparison with mechanical ventilation. Resuscitation. 1994;28:143-150.
72. Idris AH, Wenzel V, Tucker KJ, Orban DJ. Chest compression ventilation: a comparison of standard CPR and active-compression/decompression CPR. Acad Emerg Med. 1994;1:A1-7.
73. Idris AH. Reassessing the need for ventilation during CPR. Ann Emerg Med. 1996;27:569-575.
74. Noc M, Weil MH, Tang W, Turner T, Fukui M. Mechanical ventilation may not be essential for initial cardiopulmonary resuscitation. Chest. 1995;108:821-827.
75. Berg RA, Wilcoxson D, Hilwig RW, Kern KB, Sanders AB, Otto CW, Eklund DK, Ewy GA. The need for ventilatory support during bystander CPR. Ann Emerg Med. 1995;26:342-350.
76. Berg RA, Kern KB, Hilwig RW, Berg MD, Sanders AB, Otto CW, Ewy GA. Assisted ventilation does not improve outcome in a porcine model of single-rescuer bystander cardiopulmonary resuscitation. Circulation. 1997;95:1635-1641.
77. Tang W, Weil MH, Sun S, Kette D, Kette F, Gazmuri RJ, O'Connell F, Bisera J. Cardiopulmonary resuscitation by precordial compression but without mechanical ventilation. Am J Respir Crit Care Med. 1994;150:1709-1713.
78. Noc M, Weil MH, Sun S, Tang W, Bisera J. Spontaneous gasping during cardiopulmonary resuscitation without mechanical ventilation. Am J Respir Crit Care Med. 1994;150:861-864.
79. Yang L, Weil MH, Noc M, Tang W, Turner T, Gazmuri RJ. Spontaneous gasping increases the ability to resuscitate during experimental cardiopulmonary resuscitation. Crit Care Med. 1994;22:879-883.
80. Meursing BTJ, Zimmerman ANE, Van Heyst ANP. Experimental evidence in favor of a reversed sequence in cardiopulmonary resuscitation. J Am Coll Cardiol. 1983;1:610. Abstract.
81. Simoons ML, Kimman GP, Ivens EM, Hartman JA, Hart HN. Followup after out of hospital resuscitation. Read before the XII Annual Congress of the European Society of Cardiology; Sept 1990 16-20; Stockholm, Sweden.
82. Berg RA, Kern KB, Sanders AB, Otto CW, Hilwig RW, Ewy GA. Bystander cardiopulmonary resuscitation: is ventilation necessary? Circulation. 1993;88(pt 1):1907-1915.
83. Idris AH, Becker LB, Fuerst RS, Wenzel V, Rush WJ, Melker RJ, Orban DJ. Effect of ventilation on resuscitation in an animal model of cardiac arrest. Circulation. 1994;90:3063-3069.
84. Idris AH, Wenzel V, Becker LB, Banner MJ, Orban DJ. Does hypoxia or hypercarbic acidosis independently affect survival from cardiac arrest? Chest. 1995;108:522-528.
85. Clark JJ, Larsen MP, Culley LL, Graves JR, Eisenberg MS. Incidence of agonal respirations in sudden cardiac arrest. Ann Emerg Med. 1992;21:1464-1467.
86. Weil MH, Sun S, Bisera J, Tang W, Gazmuri RJ. Challenge of the ABC's of cardiopulmonary resuscitation. Chest. 1994;102:1275.
87. Cohen TJ, Tucker KJ, Lurie KG, Redberg RF, Dutton JP, Dwyer KA, Schwab TM, Chin MC, Gelb AM, Scheinman MM, Schiller NB, Callaham ML. Active compression-decompression: a new method of cardiopulmonary resuscitation. JAMA. 1992;267:2916-2923.
88. Idris AH, Wenzel V, Banner MJ, Melker RJ. Smaller tidal volumes minimize gastric inflation during CPR with an unprotected airway (abstract). Circulation. 1995;92(suppl 1):759-760.
89. Johannigman JA, Branson RD, Davis K Jr, Hurst JM. Techniques of emergency ventilation: a model to evaluate tidal volume, airway pressure, and gastric insufflation. J Trauma. 1991;31:93-98.
90. Cohen S Pathogenesis of coffee-induced gastrointestinal symptoms. N Engl J Med. 1980;303:122-124.
91. Fisher RS, Malmud LS, Lobis IF, Maier WP. Antireflux surgery for symptomatic gastroesophageal reflux: mechanism of action. Am J Dig Dis. 1978;23:152-160.
92. Bowman FP, Menagazzi JJ, Check BD, Duckett TM. Lower esophageal sphincter pressure during prolonged cardiac arrest and resuscitation. Ann Emerg Med. 1995;26:216-219.

93. Sellick BA. Cricoid pressure to control regurgitation of stomach contents during induction of anesthesia. Lancet. 1961;2:404-406.
94. Rottenberg EM, Dzwonczyk R, Reilley TE, Malone M. Use of supplemental oxygen during bystander-initiated CPR. Ann Emerg Med. 1994;23:1027-1031.
95. Idris AH, Wenzel V, Kuhilis PS, Rush WJ, Band RA, Williams JL Jr. Mouth to mouth ventilation decreases the rate of successful cardiopulmonary resuscitation in an animal model of cardiac arrest. Chest. 1997. In press.
96. Walley KR, Ford LE, Wood LD. Effects of hypoxia and hypercapnia on the force-velocity relation of rabbit myocardium. Circ Res. 1991; 69:1616-1625.
97. Hongo K, White E, Orchard CH. The effect of mechanical loading on the response of rat ventricular myocytes to acidosis. Exp Physiol. 1995;80:701-712.
98. Halperin HR, Tsitlik JE, Guerci AD, Mellits ED, Levin HR, Shi AY, Chandra N, Weisfeldt ML. Determinants of blood flow to vital organs during cardiopulmonary resuscitation in dogs. Circulation. 1986; 73:539-550.
99. Feneley MP, Maier GW, Kern KB, Gaynor JW, Gall SA Jr, Sanders AB, Raessler K, Muhlbaier LH, Rankin JS, Ewy GA. Influence of compression rate on initial success of resuscitation and 24-hour survival after prolonged manual cardiopulmonary resuscitation in dogs. Circulation. 1988;77:240-250.
100. Kern KB, Sanders AB, Raife J, Milander MM, Otto CW, Ewy GA. A study of chest compression rates during CPR in humans: the importance of rate directed chest compressions. Arch Intern Med. 1992; 152:145-149.
101. Thomas AN, Weber EC. A new method of two-resuscitator CPR. Resuscitation. 1993;26:173-176.
102. Hightower D, Thomas SH, Stone CK, Dunn K, March JA. Decay in quality of closed-chest compressions over time. Ann Emerg Med. 1995;26:300-303.
103. Milander MM, Hiscok PS, Sanders AB, Kern KB, Berg RA, Ewy GA. Chest compression and ventilation rates during cardiopulmonary resuscitation: the effects of audible tone guidance. Acad Emerg Med. 1995;2:708-713.
104. Figura N. Mouth-to-mouth resuscitation and *Helibacter pylori* infection. Lancet. 1996;347:1342. Letter.
105. Heilman KM, Muscheheim C. Primary cutaneous tuberculosis resulting from mouth-to-mouth respiration. N Engl J Med. 1965;273: 1035-1036.
106. Feldman HA. Some recollections of the meningococcal disease: the first Harry F. Dowling lecture. JAMA. 1972;220:1107-1112.
107. Finkelhor RS, Lampman JH. Herpes simplex infection following mouth-to-mouth resuscitation. JAMA. 1980;243:650. Letter.
108. Mannis MJ, Wendel RT. Transmission of herpes simplex during cardiopulmonary resuscitation training. Compr Ther. 1984;10:15-17.
109. Hendricks AA, Shapiro EP. Primary herpes simplex infection following mouth-to-mouth resuscitation. JAMA. 1980;243:257-258.
110. Todd MA, Bell JS. Shigellosis from cardiopulmonary resuscitation. JAMA. 1980;243:331. Letter.
111. Valenzuela TD, Hooten TM, Kaplan EL, Schlievert P. Transmission of 'toxic strep' syndrome from an infected child to a firefighter during CPR. Ann Emerg Med. 1991;20:90-92.
112. Ahmad F, Senadhira DC, Charters J, Acquilla S. Transmission of salmonella via mouth-to-mouth resuscitation. Lancet. 1990;335:787-788. Letter.
113. Lawrence PJ, Sivaneswaran N. Ventilation during cardiopulmonary resuscitation: which method? Med J Aust. 1985;143:443-446.
114. Braslow A, Brennan RT, Newman MM, Bircher NG, Batcheller AM, Kaye W. CPR training without an instructor: development and evaluation of a video self-instructional system for effective performance of cardiopulmonary resuscitation. Resuscitation. 1997;34:207-220.
115. Hickey RW, Cohen DM, Strausbaugh S, Dietrich AM. Pediatric patients requiring CPR in the prehospital setting. Ann Emerg Med. 1995;25:495-501.
116. Mogayzel C, Quan L, Graves JR, Tiedeman D, Fahrenbruch C, Herndon P. Out-of-hospital ventricular fibrillation in children and adolescents: causes and outcomes. Ann Emerg Med. 1995;25:484-491.
117. Whitelaw CC, Goldsmith LJ. Comparison of two techniques for determining the presence of a pulse in an infant. Acad Emerg Med. 1997;4:153-154. Letter.
118. Paradis NA, Martin GB, Goetting MG, Rivers EP, Feingold M, Nowak RM. Aortic pressure during human cardiac arrest: identification of human pseudo-electromechanical dissociation. Chest. 1992;101: 123-128.
119. Lee CS, Bullock LJ. Determining the pulse for infant CPR: time for a change? Mil Med. 1991;156:190-193.
120. Cavallaro DL, Melker RJ. Comparison of two techniques for detecting cardiac activity in infants. Crit Care Med. 1983;11:189-190.
121. Hazinski MF. Is pediatric resuscitation unique? Relative merits of early CPR and ventilation versus early defibrillation for young victims of prehospital cardiac arrest. Ann Emerg Med. 1995;25:540-543.

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RC Protocol Clearinghouse

The AARC now has a Respiratory Care Protocol Clearinghouse. RCPs interested in developing therapist-driven protocols (TDPs) for their departments can turn to the information available through the clearinghouse to get a head start on the process.

The clearinghouse makes available more than 100 TDPs submitted to the AARC by members from across the nation who have already instituted these protocols in their hospitals.

The protocols have been divided into seven packets, most of which contain ten or more sample protocols. Packets are available from the AARC at $5 each and currently cover the following subjects:

- Patient assessment
- Oxygen therapy
- Aerosol therapy
- Volume expansion
- Critical care
- Noninvasive monitoring
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Calendar of Events

Not-for-profit organizations are offered a free advertisement of up to eight lines to appear, on a space-available basis, in Calendar of Events in RESPIRATORY CARE. Ads for other meetings are priced at $5.50 per line and require an insertion order. Deadline is the 20th of the month two months preceding the month in which you wish the ad to run. Submit copy and insertion orders to Calendar of Events, RESPIRATORY CARE, 11030 Ables Lane, Dallas TX 75229-4593.

AARC & AFFILIATES

September 11-12— Pennsylvania Society

Pulmonary Conference, September 11-12 at the Sheraton Station Square, Pittsburgh.
Contact: Georgann Meyers at (412) 578-7000.

September 17–19—Maryland & District of Columbia Societies

16th Annual Educational Symposium—Conference by the Sea—at the Sheraton Fountainbleau Hotel, Ocean City, Maryland. A management track covering managed care issues is also featured.
Contact: Elgloria Harrison at (410) 578-8600 ext 211.

September 23-25—New Jersey Society

Annual Shore Conference the Tropicana Casino and Resort, Atlantic City, New Jersey. AARC Executive Director Sam Giordano will present the keynote address.
Contact: DL Planners in Atlantic City at (609) 344-1333 for brochures and specific information on registration.

September 25-26— Nebraska Society, Lincoln Pulmonologists, & Southeast Nebraska Chapter of the American Association of Critical Care Nurses

Seventh Annual Lincoln Pulmonary Conference, "Pulmonary Care Beyond 2000," Lincoln, Nebraska.
CRCE: Have been requested.
Contact: University of Nebraska-Lincoln Division of Continuing Studies at (402) 472-2844; fax (402) 472-9688.

OTHER MEETINGS

September 19-21—Extracorporeal Life Support Organization

Ninth Annual Extracorporeal Life Support Organization Meeting at the Atheneum Suite Hotel, Detroit, Michigan.
Contact: Phoebe Hankins at (313) 998-6600, e-mail: phankins@umich.edu.

September 20-21—Missouri/Kansas Association for Cardiovascular Pulmonary Rehabilitation

Conference covering the updated National Heart, Lung, & Blood Institute's guidelines for asthma, sleep disorders, and case management of cardiovascular disease, Kansas City, Missouri.
Contact: Mary Cullen at (816) 276-3984.

September 25–26—INFOCARE

Second Annual Neonatal/Pediatric Respiratory/Critical Care Symposium at the Sheraton Fiesta Beach Resort, South Padre Island, Texas.
Contact: Ralph Miller, INFOCARE, 350 San Roman Rd, Los Fresnos TX 78566, (210) 233-5645, or fax (210) 233-1010.

March 25-28, 1998—American Lung Association of the Northern Rockies

17th Annual Big Sky Pulmonary & Critical Care Medicine Conference in Big Sky, Montana.
Contact: Earl Thomas, 825 Helena Ave, Helena MT 59601-3459, (406) 442-6556; fax: (406) 442-2346, e-mail: alamtwy@aol.com.

American Association for Respiratory Care

Membership Application

Please read the eligibility requirements for each of the classifications in the right-hand column, then complete the applicable section. All information requested below must be provided, except where indicated as optional. See other side for more information and fee schedule. Please sign and date application on reverse side and type or print clearly. Processing of application takes approximately 15 days.

- ☐ Active
- Associate
  - ☐ Foreign
  - ☐ Physician
  - ☐ Industrial
- ☐ Special
- ☐ Student

Last Name _____

First Name _____

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Home Address _____

City _____

State _____ Zip __ __ __ __ __-__ __ __ __

Phone No. (_____) _____

Primary Job Responsibility (check one only)

- ☐ Technical Director
- ☐ Assistant Technical Director
- ☐ Pulmonary Function Specialist
- ☐ Instructor/Educator
- ☐ Supervisor
- ☐ Staff Therapist
- ☐ Staff Technician
- ☐ Rehabilitation/Home Care
- ☐ Medical Director
- ☐ Sales
- ☐ Student
- ☐ Other, specify _____

Type of Business

- ☐ Hospital
- ☐ Skilled Nursing Facility
- ☐ DME/HME
- ☐ Home Health Agency
- ☐ Educational Institution
- ☐ Manufacturer or supplier
- ☐ Other, specify _____

Date of Birth (optional) _____ Sex (optional) _____

U.S. Citizen? _____ Yes _____ No

Have you ever been a member of the AARC? _____

If so, when? From _____ to _____

Preferred mailing address: ☐ Home ☐ Business

For office use only

FOR ACTIVE MEMBER

An individual is eligible if he/she lives in the U.S or its territories or was an Active Member prior to moving outside its borders or territories, and meets ONE of the following criteria (1) is legally credentialed as a respiratory care professional if employed in a state that mandates such, OR (2) is a graduate of an accredited educational program in respiratory care, OR (3) holds a credential issued by the NBRC. An individual who is an AARC Active Member in good standing on December 8, 1994, will continue as such provided his/her membership remains in good standing

PLEASE USE THE ADDRESS OF THE LOCATION WHERE YOU PERFORM YOUR JOB, NOT THE CORPORATE HEADQUARTERS IF IT IS LOCATED ELSEWHERE.

Place of Employment _____

Address _____

City _____

State _____ Zip __ __ __ __ __-__ __ __ __

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FOR ASSOCIATE OR SPECIAL MEMBER

Individuals who hold a position related to respiratory care but do not meet the requirements of Active Member shall be Associate Members. They have all the rights and benefits of the Association except to hold office, vote, or serve as chair of a standing committee. The following subclasses of Associate Membership are available. Foreign, Physician, and Industrial (individuals whose primary occupation is directly or indirectly devoted to the manufacture, sale, or distribution of respiratory care equipment or supplies). Special Members are those not working in a respiratory care-related field.

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FOR STUDENT MEMBER

Individuals will be classified as Student Members if they meet all the requirements for Associate Membership and are enrolled in an educational program in respiratory care accredited by, or in the process of seeking accreditation from, an AARC-recognized agency

SPECIAL NOTICE — Student Members do not receive Continuing Respiratory Care Education (CRCE) transcripts. Upon completion of your respiratory care education, continuing education credits may be pursued upon your reclassification to Active or Associate Member.

School/RC Program _____

Address _____

City _____

State _____ Zip __ __ __ __ __-__ __ __ __

Phone No. (_____) _____

Length of program

- ☐ 1 year
- ☐ 2 years
- ☐ 4 years
- ☐ Other, specify _____

Expected Date of Graduation (REQUIRED INFORMATION)

Month _____ Year _____

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American Association for Respiratory Care Membership Application

Demographic Questions

We request that you answer these questions in order to help us design services and programs to meet your needs.

Check the Highest Degree Earned

- ☐ High School
- ☐ RC Graduate Technician
- ☐ Associate Degree
- ☐ Bachelor's Degree
- ☐ Master's Degree
- ☐ Doctorate Degree

Number of Years in Respiratory Care

- ☐ 0-2 years
- ☐ 3-5 years
- ☐ 6-10 years
- ☐ 11-15 Years
- ☐ 16 years or more

Job Status

- ☐ Full Time
- ☐ Part Time

Credentials

- ☐ RRT
- ☐ CRTT
- ☐ Physician
- ☐ CRNA
- ☐ RN
- ☐ LVN/LPN
- ☐ CPFT
- ☐ RPFT
- ☐ Perinatal/Pediatric

Salary

- ☐ Less than $10,000
- ☐ $10,001-$20,000
- ☐ $20,001-$30,000
- ☐ $30,001-$40,000
- ☐ $40,000 or more

PLEASE SIGN

I hereby apply for membership in the American Association for Respiratory Care and have enclosed my dues. If approved for membership in the AARC, I will abide by its bylaws and professional code of ethics. I authorize investigation of all statements contained herein and understand that misrepresentations or omissions of facts called for is cause for rejection or expulsion.

A yearly subscription to RESPIRATORY CARE journal and *AARC Times* magazine includes an allocation of $6.50 from my dues for each of these publications.

NOTE: Contributions or gifts to the AARC are not tax deductible as charitable contributions for income tax purposes. However, they may be tax deductible as ordinary and necessary business expenses subject to restrictions imposed as a result of association lobbying activities. The AARC estimates that the nondeductible portion of your dues — the portion which is allocable to lobbying — is 26%.

Signature _____

Date _____

Membership Fees

Payment must accompany your application to the AARC. Fees are for 12 months. (NOTE: Renewal fees are $65.00 Active, Associate-Industrial or Associate-Physician, or Special status; $80.00 for Associate-Foreign status; and $35.00 for Student status).

☐ Active	$77.50
☐ Associate (Industrial or Physician)	$77.50
☐ Associate (Foreign)	$92.50
☐ Special	$77.50
☐ Student	$35.00
TOTAL	$_____

Specialty Sections

Established to recognize the specialty areas of respiratory care, these sections publish a newsletter four times a year that focuses on issues of specific concern to that specialty. The sections also design the specialty programming at the national AARC meetings.

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TOTAL	$_____

GRAND TOTAL = Membership Fee plus optional sections **$_____**

- ☐ Total Amount Enclosed $_____
- ☐ Please charge my dues (see below)

To charge your dues, complete the following:

- ☐ MasterCard
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Card Number

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Mail application and appropriate fees to:

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RESPIRATORY CARE

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Drug Capsule: A mini-review paper about a drug or class of drugs that includes discussions of pharmacology, pharmacokinetics, and pharmacotherapy.

Graphics Corner: A brief case report incorporating waveforms for monitoring or diagnosis—with Questions, Answers, and Discussion.

Kittredge's Corner: A brief description of the operation of respiratory care equipment—with information from manufacturers and editorial comments and suggestions.

PFT Corner: Like Blood Gas Corner, but involving pulmonary function tests.

Cardiorespiratory Interactions. A case report demonstrating the interaction between the cardiovascular and respiratory systems. It should be a patient-care scenario; however, the case—the central theme—is the systems interaction. CRI is characterized by figures, equations, and a glossary. See the March 1996 Issue of RESPIRATORY CARE for more detail.

Test Your Radiologic Skill: Like Blood Gas Corner, but involving pulmonary medicine radiography and including one or more radiographs; may involve imaging techniques other than conventional chest radiography.

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Print on one side of white bond paper, 8.5 in. x 11 in. (216 x 279 mm) with margins of at least 1 in. (25 mm) on all sides of the page. Use ***double-spacing*** throughout the ***entire*** manuscript. Use a standard font (eg, Times, Helvetica, or Courier) at least 10 points in size, and

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Units of Measurement. Express measurements of length, height, weight, and volume in metric units appropriately abbreviated; temperatures in degrees Celsius; and blood pressures in millimeters of mercury (mm Hg). Report hematologic and clinical-chemistry measurements in conventional metric and in SI (*Systémé Internationale*) units. Show gas pressures (including blood gas tensions) in torr. List SI equivalent values, when possible, in brackets following non-SI values—for example, "PEEP, 10 cm H_2O [0.981 kPa]." For conversion to SI, see RESPIRATORY CARE 1988;33(10):861-873 (Oct 1988), 1989;34(2):145 (Feb 1989), and 1997;42(6):639-640 (June 1997).

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Abbreviations and Symbols. Use standard abbreviations and symbols. Avoid creating new abbreviations. Avoid all abbreviations in the title and unusual abbreviations in the abstract. Use an abbreviation only if the term occurs several times in the paper. Write out the full term the first time it appears, followed by the abbreviation in parentheses. Thereafter, employ the abbreviation alone. Never use an abbreviation without defining it. Standard units of measurement can be abbreviated without explanation (eg, 10 L/min, 15 torr, 2.3 kPa).

Please use the following forms: cm H_2O (not cmH2O), f (not bpm), L (not l), L/min (not LPM, l/min, or lpm), mL (not ml), mm Hg (not mmHg), pH (not Ph or PH), $p > 0.001$ (not p>0.001), s (not sec), S_{pO_2} (pulse-oximetry saturation). See RESPIRATORY CARE: Standard Abbreviations and Symbols [Respir Care 1997;42(6):637-642].

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MEDWATCH

THE FDA MEDICAL PRODUCTS REPORTING PROGRAM

For VOLUNTARY reporting by health professionals of adverse events and product problems

Page ___ of ___

Form Approved: OMB No 0910-0291 Expires 4/30/96
See OMB statement on reverse

FDA Use Only (Resp Care)

Triage unit sequence #

A. Patient information

1 Patient identifier
In confidence

2 Age at time of event:
or
Date of birth:

3 Sex
☐ female
☐ male

4 Weight
___ lbs
or
___ kgs

B. Adverse event or product problem

1 ☐ Adverse event and/or ☐ Product problem (e.g., defects/malfunctions)

2. Outcomes attributed to adverse event (check all that apply)
☐ death ___ (mo/day/yr)
☐ life-threatening
☐ hospitalization – initial or prolonged
☐ disability
☐ congenital anomaly
☐ required intervention to prevent permanent impairment/damage
☐ other ___

3. Date of event (mo/day/yr)

4 Date of this report (mo/day/yr)

5. Describe event or problem

6 Relevant tests/laboratory data, including dates

7 Other relevant history, including preexisting medical conditions (e.g., allergies, race, pregnancy, smoking and alcohol use, hepatic/renal dysfunction, etc.)

C. Suspect medication(s)

1 Name (give labeled strength & mfr/labeler, if known)
#1
#2

2 Dose, frequency & route used
#1
#2

3 Therapy dates (if unknown, give duration) (from/to or best estimate)
#1
#2

4 Diagnosis for use (indication)
#1
#2

5 Event abated after use stopped or dose reduced
#1 ☐ yes ☐ no ☐ doesn't apply
#2 ☐ yes ☐ no ☐ doesn't apply

6. Lot # (if known)
#1
#2

7 Exp. date (if known)
#1
#2

8 Event reappeared after reintroduction
#1 ☐ yes ☐ no ☐ doesn't apply
#2 ☐ yes ☐ no ☐ doesn't apply

9 NDC # (for product problems only)
– –

10. Concomitant medical products and therapy dates (exclude treatment of event)

D. Suspect medical device

1 Brand name

2 Type of device

3 Manufacturer name & address

4 Operator of device
☐ health professional
☐ lay user/patient
☐ other

5. Expiration date (mo/day/yr)

6.
model #
catalog #
serial #
lot #
other #

7. If implanted, give date (mo/day/yr)

8. If explanted, give date (mo/day/yr)

9. Device available for evaluation? (Do not send to FDA)
☐ yes ☐ no ☐ returned to manufacturer on ___ (mo/day/yr)

10. Concomitant medical products and therapy dates (exclude treatment of event)

E. Reporter (see confidentiality section on back)

1. Name & address

phone #

2. Health professional?
☐ yes ☐ no

3. Occupation

4 Also reported to
☐ manufacturer
☐ user facility
☐ distributor

5 If you do NOT want your identity disclosed to the manufacturer, place an " X " in this box. ☐

FDA

Mail to: MEDWATCH
5600 Fishers Lane
Rockville, MD 20852-9787

or FAX to:
1-800-FDA-0178

FDA Form 3500 1/96)

Submission of a report does not constitute an admission that medical personnel or the product caused or contributed to the e

ADVICE ABOUT VOLUNTARY REPORTING

Report experiences with:

- medications (drugs or biologics)
- medical devices (including in-vitro diagnostics)
- special nutritional products (dietary supplements, medical foods, infant formulas)
- other products regulated by FDA

Report SERIOUS adverse events. An event is serious when the patient outcome is:

- death
- life-threatening (real risk of dying)
- hospitalization (initial or prolonged)
- disability (significant, persistent or permanent)
- congenital anomaly
- required intervention to prevent permanent impairment or damage

Report even if:

- you're not certain the product caused the event
- you don't have all the details

Report product problems – quality, performance or safety concerns such as:

- suspected contamination
- questionable stability
- defective components
- poor packaging or labeling
- therapeutic failures

How to report:

- just fill in the sections that apply to your report
- use section C for all products except medical devices
- attach additional blank pages if needed
- use a separate form for each patient
- report either to FDA or the manufacturer (or both)

Important numbers:

- 1-800-FDA-0178 to FAX report
- 1-800-FDA-7737 to report by modem
- 1-800-FDA-1088 to report by phone or for more information
- 1-800-822-7967 for a VAERS form for vaccines

If your report involves a serious adverse event with a device and it occurred in a facility outside a doctor's office, that facility may be legally required to report to FDA and/or the manufacturer. Please notify the person in that facility who would handle such reporting.

Confidentiality: The patient's identity is held in strict confidence by FDA and protected to the fullest extent of the law. The reporter's identity, including the identity of a self-reporter, may be shared with the manufacturer unless requested otherwise. However, FDA will not disclose the reporter's identity in response to a request from the public, pursuant to the Freedom of Information Act.

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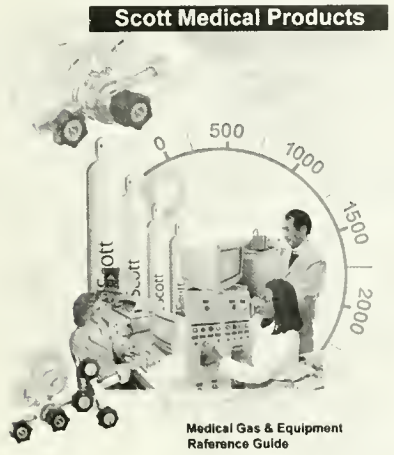

PRODUCT CATALOG. Scott Medical Products announces the availability of their 69-page, color catalog. The catalog features a full line of specialty gas products and related gas handling equipment for health care providers. In addition, the company says that the catalog contains more than 400 standard products including blood gas calibration, anesthesia calibration, respiratory diagnosis monitoring and calibration, biological incubation atmospheres and environmental calibration, surgical support, gas chromatograph, and pure gas products and equipment. The company includes a description of custom manufacturing capabilities and an 18-page technical and product information section. For a free copy, circle Reader Service Number 160.

PEDIATRIC MONITORING DEVICE. The PediCheck™ Pediatric Spot-Check Clip, used with the Dura-Y Multisite Sensor, is new from Nellcor Puritan Bennett. The clip monitors pediatric S_{pO_2} and has soft, pliable silicone sleeves that provide a comfortable fit on small fingers, the company says. The sleeves are reusable and can be cleaned and disinfected. In addition, the PediCheck is effective with patients weighing from 3-40 kg. For details, circle Reader Service Number 161.

O_2-CYLINDER CARRIER. An O_2-cylinder 3 Pack Carrier is now available from Victor Medical. The new car carrier provides a convenient and secure way to move or carry cylinders, the company says. The carrier holds up to 3 O_2 cylinders, is lightweight, and features an easy-grip handle, thumb screws that hold the cylinders in place, and a bottom stop to prevent cylinders from slipping. The 3 Pack Carrier has a 1-year warranty. For information about the carrier, available in 2 sizes for M-6 and D/E cylinders, circle Reader Service Number 164.

IRMASL UPDATED. Diametrics Medical Inc announces new features for the IRMASL Blood Analysis System. A single-use cartridge now allows clinicians to perform all critical blood gas, electrolyte, and hematocrit tests with 1 blood sample. The combo cartridge is easy to use and portable, making it useful to critical care centers and emergency health service providers, the company claims. The new AC adapter for the IRMASL is an alternative to battery power and allows the blood analysis system to be used as a portable or stationary system. The carrying bag and temperature control bag are also new features for the system. According to the company the carrying bag keeps the system handy, and the temperature control bag allows the IRMASL to operate in a variety of environmental conditions. Information about these enhancements is available, circle Reader Service Number 162.

CAPNOGRAPH-PULSE OXIMETER. SPEGAS Industries Ltd launches the NPB-75, a hand-held capnograph-pulse oximeter, for Nellcor Puritan Bennett Incorporated. SPEGAS claims that the unit, the first of its kind, is lightweight and allows for continuous monitoring of end-tidal carbon dioxide, oxygen saturation, and respiratory and pulse rate. In addition, the product is enhanced by the patented Microstream CO_2 measurement technology that uses an infrared source for the detection of CO_2. The company will supply information; circle Reader Service Number 163.

Notices

Notices of competitions, scholarships, fellowships, examination dates, new educational programs, and the like will be listed here free of charge. Items for the Notices section must reach the Journal 60 days before the desired month of publication (January 1 for the March issue, February 1 for the April issue, etc). Include all pertinent information and mail notices to RESPIRATORY CARE Notices Dept, 11030 Ables Lane, Dallas TX 75229-4593.

Final Deadline: October 1, 1997 for AARC's $1,000,000 Research Program

Research designed to study the relationships between clinical interventions by respiratory care professionals (RCPs) and the outcomes of care may qualify for research grants available from the American Association for Respiratory Care.

The agenda for this research project includes the examination of the outcomes of care provided by RCPs with expanded roles and/or scope of practice in various settings and outcomes of systems of respiratory care services delivery in various settings.

The researcher(s) will be sent a complete application when the "Research Plan Abstract" form is approved. To obtain the abstract form or for more information, call (972) 243-2272. Hurry! the final deadline is October 1, 1997.

1997 RC Week

National Respiratory Care Week October 12-18, 1997

Ideas and products for Respiratory Care Week are available in this issue and the 1997 RC Week Catalog mailed with the June issue of *AARC Times*. Call the RC Week hotline at (972) 406-4684.

Helpful Web Sites

American Association for Respiratory Care
http://www.aarc.org
Free access to MEDLINE is now available on our web site

National Board for Respiratory Care
http://www.nbrc.org

Applied Measurement Professionals Inc
http://www.applmeapro.com

The American Academy of Pediatrics
http://www.aap.org

Extracorporeal Life Support Organization
http://www.med.umich.edu/elso/

U.S. Department of Health and Human Services, Health Advice
http://www.healthfinder.gov

Food and Drug Administration
http://www.fda.gov

National Asthma Education Prevention Program Guidelines, 2nd Edition
http://www.nhlbi.nih.gov/nhlbi/lung/asthma/prof/asthgdln.htm

The National Board for Respiratory Care—1997 Examination Dates and Fees

Examination	Examination Date	Examination Fee	
CRTT Examination	November 8, 1997	$100	(new applicant)
	Application Deadline: September 1, 1997	60	(reapplicant)
RRT Examination	December 6, 1997	210	(new applicant)
	Application Deadline: August 1, 1997	170	(reapplicant)
RPFT Examination	December 6, 1997	160	(new applicant)
	Application Deadline: September 1, 1997	130	(reapplicant)

For information about other services or fees, write to the National Board for Respiratory Care, 8310 Nieman Road, Lenexa KS 66214, or call (913) 599-4200, FAX (913) 541-0156, email nbrc-info@nbrc.org.

Roger C Bone, Former RESPIRATORY CARE Editorial Board Member, Dies

Roger C Bone MD, an Honorary Member of the American Association for Respiratory Care since 1990 and a member of the RESPIRATORY CARE Editorial Board—1983-1986, died Sunday, June 8, 1997. He was 56.

Since 1993, Bone battled renal cancer, an experience that brought about extensive writings about the process of dying. During his life, Bone authored more than 1,000 articles and edited more than 56 books. In addition, Bone served as president of the American College of Chest Physicians and the International Academy of Chest Physicians and Surgeons. While serving as an army captain in Vietnam from 1967 to 1969, Bone received the Medal of Valor for removing a live grenade from a wounded American soldier.

At his death, Bone was a distinguished professor of medicine at Rush-Presbyterian-St Luke's Medical Center and former dean of the Rush Medical College in Chicago, 1992 to 1993. He is survived by his wife, Rosemary, and two daughters, Mary Katherine Krause and Cynthia Larson.

The Lambda Beta Society
The National Honor Society for the Profession of Respiratory Care

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the National Honor Society for the
Profession of Respiratory Care,
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PO Box 15945-292, Lenexa KS 66285
(913) 541-9077

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3. ❑ Subacute Care Facility
4. ❑ Home Care Practice
5. ❑ School
6. ❑ Distributor

II. Department
A. ❑ Respiratory Care
B. ❑ Cardiopulmonary
C. ❑ Subacute Care
D. ❑ Home Care

III. Specialty
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4. ❑ Research
5. ❑ Subacute Care
6. ❑ Diagnostics/ Pulmonary Function
7. ❑ Management
8. ❑ Home Care
9. ❑ Rehabilitation
10. ❑ Education

IV. Position
A. ❑ Department Head
B. ❑ Chief Therapist
C. ❑ Supervisor
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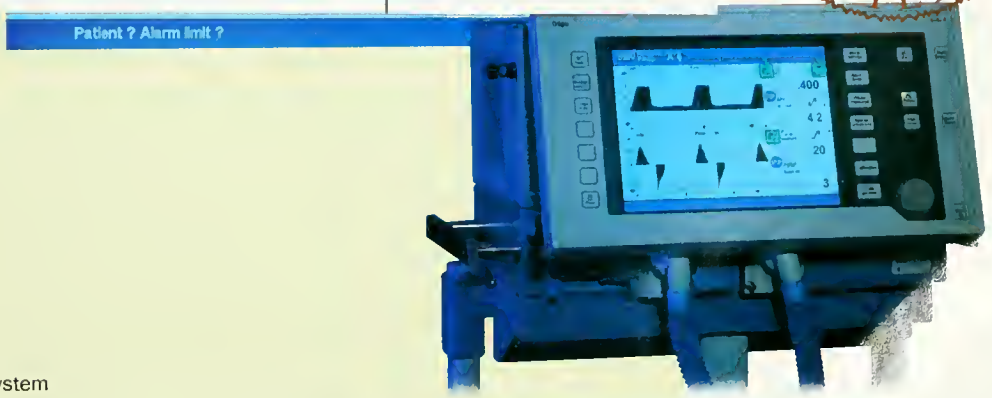

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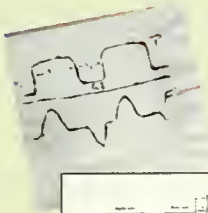
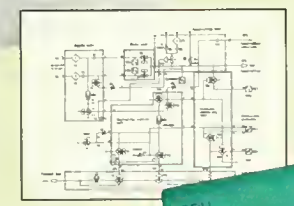
STOP THE CONFLICT...

BETWEEN PATIENT AND VENTILATOR

Dräger



Let your patient cough or breathe unrestricted during controlled ventilation!



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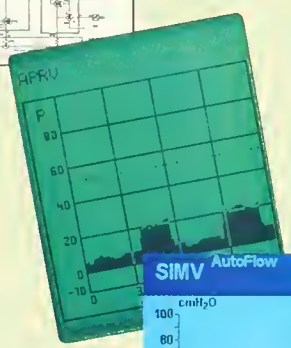

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